IMPLEMENTATION AND EVALUATION OF PHARMACEUTICAL CARE SERVICE IN SUDANESE ASTHMATIC PATIENTS

A Thesis submitted

By

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Dedication

To my husband (Yasir)
In appreciation of his tolerance, patience and sacrifices

To my parents, brothers and sisters who have been
evolving sources of inspiration and hope

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Abstract

Asthma is increasing all over the world particularly in developing countries such as Sudan. Major questions for researchers will arise such as is there evidence that asthma is appropriately treated in Sudan; is there evidence that the asthmatic patients are provided with the best health care, is the contribution of the pharmacists in asthmatic patients care will improve their outcomes. From these questions the objectives of this research work were developed, they include the investigation of the current prescribing practices for the treatment of chronic and acute attacks of asthma, and the evaluation of the impact of implementing a pharmaceutical care service in Sudanese asthmatic patients.

The present study was conducted at Shaab teaching hospital in Khartoum state. Prescribing practices of chronic asthma were investigated through systematic random collection of ١٢٥ prescriptions. It was revealed that the minimum information required to be in the prescriptions were missed in many of them. The name of the medicine was not clearly written due to bad handwriting or spelling mistakes in ٣٢٪ of the prescriptions. The strength of the drug and the quantity to be dispensed were not shown in ٦٨٪ and ٨٠,٨٪ of the prescriptions, respectively. The dosage form and the directions for use were not written in ٣,٢٪ and ٤٪ of the prescriptions, respectively. In ٦٩,٦٪ of the prescriptions the number of drugs prescribed was in the range of ١-٢ drugs / prescription, while three and four drugs were prescribed in ٢٤٪ and ٦,٤٪ of the prescriptions, respectively. Potential drug -drug interactions were identified in ١,٦٪ of the prescriptions. The dose of inhaled steroids was written appropriately in ١٣,٥٪ of the prescriptions. Oral steroids dose was inappropriate in ١٥,٢٪ of the prescriptions. The pattern of prescribing in chronic asthma management was of low quality due to the low ratio of prescribing preventors to bronchodilators [٠,٤]. Antibiotics were prescribed in ٣٥,٢٪ of the prescriptions.

Management of acute attacks of asthma was investigated through retrospective, systematic random collection of ٢٥٠ admission sheets. The results showed that the vital signs (Pulse, Respiratory rate and Blood pressure) were not reported in ٣٢,٤٪ of the collected sample. Full medical history was written in ٤ % of the sheets and none of the patients was assessed by the peak expiratory flow rate. The results of evaluating the appropriateness of the management of acute attacks as written in the admission sheets revealed that oxygen was prescribed for ١٤,٤ % of the patients without indicating the concentration that should be administered to them. Irrational prescribing of nebulized salbutamol and intravenous aminophylline was also revealed. The steroids were prescribed in ٩٣,٢ % of the admission sheets, ٢٠٠ mg of intravenous hydrocortisone as single dose not followed by prednisolone was prescribed in ٦٤,٤٪ of the sheets and inadequate dose of ١٠٠ mg hydrocortisone were found in ٢٥,٤٪ of the sheets. The study revealed inappropriate management of acute exacerbations of asthma.

The study of evaluating the impact of implementing a pharmaceutical care service in Sudanese asthmatic patients was carried out in ١٠٠ patients; they were randomly allocated in two groups, control group (٤٠) and intervention group (٦٠). The study results have shown that patients in the intervention group had better final outcomes than patients in the control group. The intervention patients had significant better asthma symptom status, reduction in the occurrence of nocturnal asthma symptoms, the use of inhaled β_2 agonists, days of sickness and rate of hospitalization. Although the number of patients in this study was small, its findings imply that the pharmacist's intervention had an effect in terms of improving the quality of care for asthmatic patients.

The findings of this study have shown that the patients in the intervention group had better intermediate outcomes than those in the control group. The intervention patients had better improvement in the peak expiratory flow rate, technique of inhaler use, asthma and drug knowledge, patients' compliance to drug and non-drug therapy and the ratio of prescribing inhaled steroids to bronchodilators. The face-to-face education of asthmatic patients in the intervention group facilitated the individual learning needs and provided patients interactions and their involvement in decisions regarding their appropriate treatment.

In conclusion, the present results pointed out the common prescribing errors in the prescribing practices for the treatment of chronic asthma and acute exacerbations of asthma and demonstrated the need for establishment of the updated national guideline for the management of asthma, continuing medical education, supervision and monitoring of the prescribing practices. Also it showed that the pharmacist led-interventions resulted in improved management of the asthmatic patients. The results support the value of collaboration between physicians, pharmacists and patients, which improved prescribing, solved drug therapy–related problems and improved the quality of care for asthmatic patients.

مستخلص الدراسة

ازدادت الاصابة بمرض الربو في جميع أنحاء العالم وبصفة خاصة الدول النامية كالسودان . هنالك العديد من المشاكل المتعلقة بوصف الأدوية والعناية الطبية لمرضى الربو .
أجريت هذه الدراسة في مستشفى الشعب التعليمى بهدف أستقصاء الممارسات في وصف الأدوية لمعالجة الربو المزمن، وقد جمعت عينات عشوائية من ١٢٥ وصفة طبية وأسفرت نتيجة التحليل عن أن كثير من الوصفات الطبية تفتقر للمعلومات الاساسية فمثلاً ٣٢% تحتوى على اخطاء املائية لكتابة الأدوية وكثيراً ما يكون الخط غير واضح ، كما أن تركيز الدواء والكمية المطلوبة منه لعلاج المريض غير محددة في ٦٨% ١٨,٨% على التوالى، شكل الصيدلانى للدواء وطريقة استخدامه غير موضحة في ٣,٢% و ٤% من الوصفات على التوالى.
كان عدد الأدوية الموصوفة في ٦٩,٦% من الوصفات دواء واحداً إلى اثنين بينما احتوت ٢٤% من الوصفات على ثلاثة أدوية و ٦,٤% من الوصفات على أربعة أدوية وكانت الجرعة بالنسبة (الستيرويدات Steroids) التى تعطى عن طريق الاستنشاق غير صحيحة في ١٣,٥% بينما كانت الجرعات غير صحيحة في ١٥,٢% من الستيرويدات التى تعطي عن طريق الفم.
أظهرت الدراسة ان الممارسة في وصف الدواء بالنسبة لمرضي الربو المزمن انخفاض نوع التحكم الوصفي لارتفاع نسبة الادوية الموسعة للشعب الهوائية عن تلك الوقاية.
لاستقصاء الممارسات في وصف الأدوية لمعالجة الربو الحاد أجريت دراسة عن طريق جمع عينة عشوائية مكونة من ٢٥٠ استمارة لدخول غرفة الطوارئ واسفرت الدراسة على أن ٣٢,٤% من الاستمارات لا تحتوى على المعلومات الأساسية لتقويم المريض مثل قياس النبض ومعدل التنفس وضغط الدم.
٤% فقط من الاستمارات احتوت على التقرير الكامل عن التاريخ الطبي للمريض.
وصف الأكسجين في ١٤,٤% من الاستمارات من غير تركيز محدد للكمية التى يجب إعطاؤها للمريض.
وصفت الستيرويدات في ٩٣,٢% من الاستمارات وكانت الجرعة غير صحيحة في ٢٥,٤% من الاستمارات حيث وصف للمرضي ١٠٠ ملغ من عقار الهيدروكورتيزون بينما وصفت ٢٠٠ ملغ بنسبة ٦٤,٤% ولكنها لم تكتمل بوصف عقار البردنسولون.

أسفرت الدراسة عن أن الممارسة في وصف الأدوية بالنسبة للنوبات الربوية الحادة غير واف.
تطبيق وتقويم تجربة الرعاية الصيدلانية في مرضي الربو في السودان أجريت على عينة عشوائية احتوت على ١٠٠ مريض وقد قسم المرضي مجموعتين، مجموعة التدخل التقويمي (Intervention) وقد شملت ٦٠ مريض بينما احتوت المجموعة القياسية (Control) ٤٠ مريض ، وقد اظهرت مجموعة التدخل التقويمي تحسناً ذا دلالة إحصائية واضحة مقارنة بالمجموعة القياسية في تقليل معدل الأعراض الربوية الليلية في الأسبوع وعدد أيام العسر المرضي ، كما أوضحت تقليلاً واضحاً في استهلاك مستقبلات بيتاً الادرينرجية (Inhaled β٢ agonists) خلال الأسبوع ونسبة الاستجمام.
بالرغم من أن عدد المرضي لهذه الدراسة كان قليل جداً لكن النتائج توضح التدخل الصيدلانى له تأثير كبير في تحسين الاهتمام بمرضي الربو.
أوضحت النتائج أن المرضي لمجموعة التدخل الصيدلانى لها نتائج فورية مقارنة بالمجموعة القياسية وأظهرت تحسناً واضحاً في زيادة معدل الزفير (peak expiratory flow rate) وفي اسلوب استخدام الرذاذات الهوائية معرفة المريض بمرض الربو والأدوية المستخدمة في علاجه وارتباط المرضي بالعلاج الدوائى وغير الدوائى. كما زادت نسبة وصف الأدوية الوقائية بالنسبة للأدوية الموسعة للشعب الهوائية.
التعليم المباشر لمرضي الربو في مجموعة التدخل التقويمي الصيدلانى عملت على سد احتياجات الفرد وزوت المرضي بالتكامل والتفاعل واتخاذ القرارات بشأن علاجهم المناسب.
أوضحت النتائج أن الأخطاء في وصف الأدوية لعلاج الربو المزمن والنوبات الربوية الحادة الحوجة لوضع سياسة دوائية قومية لتوجيه وإدارة التعليم المستمر للمرضي والاشراف والمراقبة للوصفات الطبية الخاصة بمرضى الربو.
اوضحت الدراسة ان التدخل التقويمي الصيدلانى قد اسفر عن نتائج ذات دلالة احصائية واضحة في التحسن لمرضي الربو ودعمت النتائج قيمة التعاون المتبادل بين الأطباء والصيادلة والمرضي التى ادت الى تحسن واضح في ممارسات وصف الأدوية وحل المشاكل المتعلقة بالمعالجة الدوائية وغير الدوائية لمرضي الربو كما حسنت من العناية الطبية لمرضى الربو.

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Introduction

١,١ Overview of Asthma

١,١,١ Definition

Asthma is defined as" *a chronic inflammatory disorder of the airways in which many cells play a role, particularly mast cells, eosinophils and T lymphocytes. In susceptible individuals, this inflammation causes recurrent episodes of expiratory wheezing, breathlessness, chest tightness and cough particularly at the night and/or in the morning. These symptoms are usually associated with widespread, but variable, airflow limitation that is at least partly reversible, either spontaneously or with treatment. The inflammation also causes an associated increase in airways responsiveness to a variety of stimuli"*
This definition was published in ١٩٩٥ following a series of workshops comprising international experts as a part of a Global Initiative for Asthma (GINA), sponsored by WHO and the national Institute of Health (Ratko and Stephen, ١٩٩٩).

١,١,٢ Epidemiology

The exact prevalence of asthma remains uncertain due to the difficulty in defining the disease. Asthma is a worldwide problem, which occurs in all races, its prevalence varies from less than ١٪ to as high as ٣٠٪ of the populations in different countries. In ٢٠٠٠, WHO reported that between ١٠٠ and ١٥٠ million people around the world suffer from asthma and that worldwide deaths from asthma reached over ١٨٠،٠٠٠ annually. There is a strong evidence that its prevalence is increasing throughout the world as reported by WHO that around ٨٪ of Swiss population suffers from asthma compared to ٢٪ during the previous ٢٥-٣٠ years and in USA the number of asthmatics increased by ٦٠٪ since ١٩٨٠s with deaths being doubled to ٥،٠٠٠ a year. However, in developing countries the incidence of the disease varies greatly .For example in India the number of asthmatics estimated as ١٥-٢٠ million; in Kenya it approaches ٢٠٪ of the population; and in Brazil, Costa Rica, Panama, Peru and Uruguay its prevalence in children varies from ٢٠٪-٣٠٪(WHO, ٢٠٠٠). This rate of increase in prevalence can be attributed to the environmental changes such as increasing exposure to allergens and pollutants rather than genetic factors, which cannot be ignored in predisposing individuals to develop asthma **(**Ratko and Stephen, ١٩٩٩). The economic and social impact of asthma is estimated to exceed those of TB and AIDS. The direct costs due to hospitalization and drugs accounted for $ ٦,١ billion dollars in USA, $١,٨ billion dollars in Britain and $ ٤٦٠ million dollars in Australia (WHO, ٢٠٠٠).

١,١,٣ Classification of Asthma

a] Allergic Asthma

It is also known as atopic (allergic) asthma [IgE-mediated], which is triggered by external allergens. It is often observed in children and young adults and usually associated with atopic features such as eczema and allergic rhinitis.

b] Non-allergic Asthma

It is also known as non-atopic asthma [non-IgE mediated] of unknown origin, which is triggered by non-allergenic factors such as viral infections and sensitivity to aspirin. It is usually observed in adults and associated with normal level of serum IgE.

- **Classification According to Severity** (Ratko and Stephen, ١٩٩٩)

This classification is based on clinical features and requirements for treatment, it also combined the clinical symptoms, spirometry and, peak expiratory flow (PEF) variation:

i] Intermittent

- Symptoms < once/ week.
- Brief exacerbations (from few hours to few days).
- Night-time asthma symptoms < twice/month.
- Asymptomatic and normal lung function between exacerbations.
- PEF or FEV_1 > ٨٠٪ of the predicted value; < ٢٠ %variability.

ii] Persistent

a) Mild Persistent

- Symptoms > once/ week, but < once/day.
- Exacerbations may affect activity and sleep.
- Night-time asthma symptoms > twice/month.
- PEF or FEV_1 > ٨٠٪ of the predicted value, ٢٠-٣٠ % variability.

b) Moderate Persistent

- Symptoms daily
- Exacerbations may affect activity and sleep.
- Night-time asthma symptoms > once/week.
- Daily use of inhaled short acting β_2 -agonist.
- PEF or FEV_1 > ٦٠٪ - < ٨٠٪ of the predicted value, > ٣٠ % variability.

c) Severe Persistent

- Continuous symptoms.
- Frequent exacerbations.
- Frequent night-time asthma symptoms.
- Physical activities limited by asthma symptoms.
- PEF or FEV_1 < ٦٠٪ of the predicted value, > ٣٠ % variability.

١,١,٤ Pathophysiology of Asthma

The main features of asthma are marked hypertrophy and hyperplasia of bronchial smooth muscles, mucus gland hypertrophy leading to excessive mucus production and inflammatory cell migration, which lead to damaged epithelium, mucosal oedema and impaired mucociliary clearance.

A specific cellular defect has not been identified yet but there are a number of pathophysiological features that are prevalent in asthma such as a defect in cholinergic activity in the airways, abnormal β-receptor adenylate cyclase function that leads to a decrease in adrenergic responsiveness. There is evidence that alpha-receptors may trigger bronchoconstriction in some patients (Gibbs and Portlock, ٢٠٠١).

It is thought that the final common pathway in asthma is altered regulation of intracellular calcium due to the fact that most of the signs and symptoms of asthma are calcium-dependent processes including the release of mediators from mast cells, smooth muscle contraction, mucus secretion, vagus nerve impulse conduction and inflammatory cell infiltration (Gibbs and Portlock, ٢٠٠١).

The proposed key mechanism in allergen- induced asthma is the release of mast cell components (histamine, leukotrienes, prostaglandins, bradykinins, adenosine, prostaglandin-generating factor of anaphylaxis, various chemotactic agents that attract eosinophils and neutrophils) as a result of an IgE mediated reaction on the surface of the cell.

The activities of these mediators are described as follows:
a) Histamine triggers rapid bronchoconstriction.
b) Leukotrienes (LTs) such as LTC_4, LTD_4, and LTE_4 are potent bronchoconstrictors
c) Chemotactic agents cause slower reaction characterized by infiltration of macrophages into the lumen of the airways that release prostaglandins, thromboxane and platelet activating factor (PAF).
d) PAF sustains the bronchial hyper- reactivity and causes leakage of plasma from respiratory capillaries that increase mucosal oedema. It also facilitates accumulation of eosinophils within the airways.
e) Eosinophils release various inflammatory mediators such as LTC_4 and PAF resulting in epithelial damage and production of thick viscous mucus that causes further deterioration in lung function.

The mucus production is a normal defense mechanism but in asthmatics it is increased in bronchial glands and goblet cells. The mucus transport depends on its viscosity and if it is very thick it plugs the airways, which is also blocked by epithelial and inflammatory cell debris. Mucociliary clearance is also decreased due to inflammation of epithelial cells. The epithelial cell damage can be severe and can increase access of various irritants to cholinergic receptors (Gibbs and Portlock, ٢٠٠١).

١,١,٥ Diagnosis

Asthma can present in many ways, the most common is recurrent episodes of difficulty in breathing (dyspnoea) associated with wheezing. It can be diagnosed by a combination of a full history from the patient or patient's representative and lung function tests before and after administration of bronchodilators. The history of an asthmatic patient often includes the presence of atopy and allergic rhinirtis in the patient or within the close relatives**.** Improvement of chest tightness, shortness of breathing and abnormal lung function test by ١٥٪ after administration of a suitable bronchodilator will confirm its diagnosis. However, if there is no improvement in ventilation this cannot rule out asthma (Gibbs and Portlock, ٢٠٠١).

As well as other respiratory diseases such as chronic obstructive airways disease (COAD) asthma can be assessed by a series of routine tests, but the most useful and reproducible test is the FEV١/FVC ratio. Forced expiratory volume (FEV) can be measured when the patient inhales as deeply as possible and then exhales as forcefully and completely as possible into a mouthpiece connected to the spirometer. $FEV_١$ is a measure of the forced expiratory volume in the first second of exhalation. Forced vital capacity (FVC) is another volume that is commonly measured and it is the maximum volume of air exhaled with maximum effort after maximum inspiration. Normal individuals can exhales at least ٧٥٪ of their total capacity in one second and any reduction indicates deterioration in lung performance (Gibbs and Portlock, ٢٠٠١).

The peak flow meter is a useful means of self-assessment for the patient. Although its results are less reproducible than the spirometer but it can be used to assess the improvement or deterioration in the disease as well as the effectiveness of the treatment. It measures peak expiratory flow rate (PEFR), which is the maximum flow rate that can be forced during expiration (Gibbs and Portlock, ٢٠٠١).

The normal values for FEV١, FVC and PEFR, which are compared with those of the patient, vary with age, race, gender, height and weight. The three measurements do not detect early deterioration of lung function and mucus plugging in the small airways; the diagnosis is usually confirmed by the response to a bronchodilator. Assessment of partial pressure of oxygen $PaO_٢$ (reference range١٢-١٦ kPa) and carbon dioxide $PaCO_٢$ (reference range ٤,٦ - ٦,٠ kPa) in arterial blood, together with PH reference range ٧,٣٥-٧,٤٥) are routinely monitored in patients hospitalized with severe acute asthma (Gibbs and Portlock, ٢٠٠١).

١,٢ Treatment of Asthma

١,٢,١ Aims of Treatment

i] To control symptoms, minimize anxiety and permit normal life as possible.
ii] To educate the patient about the disease and its treatment.
iii] To identify trigger factors, thus minimizing morbidity and mortality.

١,٢,٢ General Measures

i] Environmental control as far as possible.
ii] Smoking cessation in both patients and their families.
iii] Stress reduction by effective treatment and educating patients about their disease.
iv] Prompt control of common cold and infection.
v] Physiotherapy: the humid atmosphere of swimming bath helps to avoid exercise induced attacks.
vi] Counseling of the patients to understand the nature of the disease and how to prevent the exacerbations and manage them effectively.

١,٢,٣ Pharmacotherapy

Asthma is a potentially life-threatening disease that is often under-treated. In the management of asthma, there are common therapeutic problems, which are reported such as its under-diagnosis especially in the elderly, failure of the avoidance or reduction of allergens, poor patient knowledge about asthma and its management, the use of anti-inflammatory therapy on as required basis rather than regularly, missing the signs of rapidly deteriorating asthma by the patients or health professionals, incorrect technique in the use of inhalers (Gibbs and Small, ٢٠٠٣).

Drug therapy is directed towards reducing inflammation and increasing bronchodiltation. Table [١] shows a general approach to the treatment of target features in asthma. The main goals of treatment are restoration of normal airways function and prevention of severe acute attacks. The choice of the drug therapy of asthma depends on the frequency and severity of the patient's symptoms (Gibbs and Portlock, ٢٠٠١). The guidelines for the management of chronic asthma in adults and children as recommended by The British Thoracic Society in ١٩٩٧ will be discussed in the introduction of the study for the assessment of treatment for chronic asthma (chapter ٢). Management of acute severe attacks will be discussed in the introduction of the study for the assessment of emergency treatment of asthma (chapter ٣).

Table [١،١] General Approach to the Treatment of Target Features in Asthma

Target Feature	Therapeutic Aim	Drugs Used	Examples
١) Inflammation and bronchial hyper-reactivity	a) Reduce • eosinophil recruitment and activation • lymphocyte activity • toxicity to epithelial cells	Corticosteroids	Beclomethasone Budesonide Prednisolone
	b) Reduce mast cell degranulation	Inhibitors of mediator release	Sodium cromoglycate Nedocromil sodium Theophylline (?) Selective β_2 agonist
٢)Bronchoconstriction	Bronchodilatation a) Increase sympathomimetic activity	Selective β_2 agonist	Short-acting: Salbutamol, Terbutaline, Fenoterol, Reproterol, Long-acting: Salmeterol, Bambuterol, Eformoterol
	b) Block parasympathetic activity	Antimuscarinic	Ipratropium, Oxitropium
	b) Increase cAMP levels in bronchiolar muscle cells	Phosphodiesterase inhibitor	Aminophylline Theophylline

(?) : Their precise mode of action is unknown, possible or secondary action

١,٢,٤ Drugs used in Treatment of Asthma

I] Selective β_2-Adrenergic Receptors Agonists

Pharmacodynamics

The stimulation of β_2-receptors in the bronchioles leads to the activation of adenylyl cyclase resulting in increased levels of intracellular cAMP and consequent bronchodilatation (Johnson and Coleman, ١٩٩٥). Also they have been shown to increase potassium channels conduction in airway muscle cells leading to membrane hyperpolarization and relaxation, this mechanism is independent of adenylyl cyclase activity and cyclic AMP (Kume *et al.,* ١٩٩٤).

There are secondary beneficial effects when long acting β_2 agonists used in prophylaxis, they exert anti-inflammatory effect through the inhibition of the function of some inflammatory cells by elevating the intracellular cAMP that leads to the inhibition of the release of the inflammatory mediators and cytokines (Lichtenstein and Margolis, ١٩٦٨).

Pharmacokinetics

Short-acting β_2 agonists when given by inhalation have an onset of action within ١-٥ minutes and produce bronchodilatation that lasts for about ٢-٦ hours, but when given orally their duration is ٤-٨ hours. The preferable- route of administration is the inhalation.
Long acting β_2-agonists mainly used in asthma prophylaxis, they provide persistent bronchodiltation lasting over ١٢ hours.

Side Effects:

Side effects are common when administered orally, parentrally or through excessive inhalation. These include skeletal muscle tremors, tachycardia, restlessness, apprehension and anxiety. Increased plasma free fatty acids, glucose and lactate, hypokalemia and exacerbation of angina are associated with high doses.

Precautions

Beta$_2$-agonists should be used with caution in patients with hyperthyroidism, cardiovascular disease, arrhythmia and hypertension. They should be used with caution in pregnancy and breast-feeding, but the benefit of asthma control outweighs any slight effects on mother or fetus. Blood glucose of diabetics should be monitored for the risk of ketoacidosis especially when administered intravenously.

Drug interactions

i] Corticosteroids:Increased risk of hypokalemia with high dose β_2-agonists.

ii] Theophylline: Increased risk of hypokalemia with high dose β_2-agonists.

iii] Beta-blockers: Antagonize the bronchodilating effect of β^2-agonists.

Dosage

i] **Salbutamol**

- Aerosol Inhalation: ١٠٠-٢٠٠ug (١-٢ puffs) up to ٣-٤ times daily for persistent symptoms.
- Nebulized Solution Inhalation: Adult and child over ١٨ months ٢,٥ mg repeated up to ٤ times may be increased to ٥ mg if necessary.
- Oral: Adult (٦-١٦mg in ٣-٤ divided doses/day). >٢years (٤٠٠μg /kg in ٤ divided doses/day); ٢-٦years (٣-٨mg in ٣-٤ divided doses/day); ٦-١٢ years (٦-٨mg in ٣-٤ divided doses).

ii] **Terbutaline**

- Aerosol Inhalation: ٢٥٠-٥٠٠ug (١-٢ puffs) up to ٣-٤ times daily for persistent symptoms.
- Nebulized Solution Inhalation: Adult (١٠-٤٠mg in ٢- ٤ divided doses daily); up to ٣years (٢ mg); ٣-٦years (٣mg); ٦-٨years (٤mg) ;>٨years (٥mg) ٢-٤ times daily.
- Oral: initially ٢,٥ mg ٣ times daily for ١-٢ weeks, then up to ٥mg ٣ times daily. Child ٧٥ μg /kg ٣ times/daily; ٧-١٥ years ٢,٥ mg ٢-٣ times daily.

iii] **Salmeterol**

- Aerosol Inhalation: ٥٠ μg (٢ puffs) twice daily up to ١٠٠μg (٤ puffs) twice daily in more severe airways obstruction. Child under ٤ years not recommended, > ٤ years ٥٠ μg (٢ puffs) twice daily.

iv] **Eformoterol**

- Inhalation of powder: Adult and child > ١٢ years ٦-١٢μg once or twice daily.

II] Antimuscarinic Bronchodilators

Pharmacodynamics

They competitively and selectively block the action of acetylcholine at the muscarinic receptors in the lungs, reducing cGMP and hence decreasing muscle tone and producing dilatation of both larger and small airways. A synergistic bronchodilating effect is produced when they are combined with β_2-agonists; this effect is of great importance in emergency treatment of acute asthma exacerbations (Bryant and Roger, ١٩٩٢). They are useful in older, chronic asthmatics with decreased responsiveness to β_2-agonists; also they are more effective in relieving bronchoconstriction associated with chronic obstructive pulmonary disease.

Pharmacokinetics

The aerosol inhalation of ipratropium has maximum effect ٣٠-٦٠ minutes after use with duration of action of ٣-٦hours and its effect maintained by administration three times a day.

Side Effects

Acute angle- closure glaucoma has been reported in patients given nebulised ipratropium .Dry mouth; urinary retention and constipation are rarely reported.

Dosage

Ipratropium

- Aerosol Inhalation: Adult ٦٠-٣٢٠ μg in ٣-٤ divided does daily.
  Child ٢٠-١٢٠ μg in ٣-٤ divided doses.
- Nebulized Solution Inhalation: Adult ١٠٠-٥٠٠ μg up to four times daily.
  Child ٣-١٤years ١٠٠-٥٠٠μg in up to ٣ times daily

III] Theophylline

Pharmacodynamics

The mechanism of action of theophylline may be through inhibiting cyclic nucleotide phosphodiesterase enzymes (PDEs), which lead to accumulation of cAMP in cells and causing airways relaxation. It is also a competitive antagonist at adenosine receptors that mediate adenosine-induced bronchospasm (Fredholm and Person, ١٩٨٢). Adenosine is known to cause bronchoconstriction in asthmatics and potentiate immunologically induced mediator release from human lung mast cells (Cushley *et al*., ١٩٨٤; Peachell *et al*., ١٩٨٨).

Other actions of theophylline include the direct effects on intracellular $Ca^{٢+}$ concentration and indirect effect via cell membrane hyperpolarization and the uncoupling of intracellular $Ca^{٢+}$ from muscular contraction. There is evidence that cAMP modulation of intracellular Ca levels, may be a common pathway for bronchodilatation. The action of theophylline to mobilize intracellular $Ca^{٢+}$ may prove to be its principal effect (Gibbs and Small, ٢٠٠٣).

Theophylline is the most potent bronchodilator used for reversible airways obstruction and the treatment of acute severe asthma (Fanta *et al.,* ١٩٨٦; Rossing *et al*., ١٩٨٠). Nocturnal asthma can be improved with slow-release theophylline preparations (Self *et al*., ١٩٩٢). Now the role of theophylline in treatment of

chronic asthma is far less prominent due to its narrow therapeutic index and the requirement for monitoring of its plasma levels (Stoloff, ١٩٩٤; Nasser and Rees, ١٩٩٣).

Pharmacokinetics

Methylxanthines are absorbed readily from oral and parentral administration. Absorption from rectal suppositories is slow and unreliable but it is absorbed completely from liquids, uncoated tablets and some but not all sustained–release preparations (Hendeles and Weinberger, ١٩٨٢). Its maximal plasma concentration is achieved within ٢ hours after the administration of uncoated tablets in an empty stomach.

Sustained release preparations designed to provide therapeutic plasma levels that persist over about ١٢ h, peak levels tend to occur after about ٨ hours, thus the evening dose should be taken at about ٨ p.m to control nocturnal asthma and early morning wheezing**.** The use of short-acting oral formulations should be discouraged due to the high incidence of adverse effects associated with their rapid release and absorption; and their highly variable clearance. They also provide unpredictable and short duration of action (Gibbs and Small, ٢٠٠٣).

Its elimination half-life is increased in heart failure, liver cirrhosis, viral infection, elderly and concomitant administration with hepatic microsomal enzyme inhibitors. Its elimination half-life is decreased in smokers, chronic alcoholism and concomitant administration with hepatic microsomal enzymes inducers. These changes in half-life are very important as theophylline has a narrow therapeutic index; in most subjects ١٠-٢٠mg/L plasma concentration is required for satisfactory bronchodilation, although ١٠mg/L or less may be effective, but side effects may occur at plasma level of ٢٠mg/L. The amount of drug excreted renally is only ١٠٪, thus renal impairment should not affect blood levels significantly unless there is renal failure (Gibbs and Small, ٢٠٠٣).

Theophylline is used parenterally as aminophylline (a mixture of theophylline with ethylenediamine) that has ٢٠ times higher solubility than theophylline. It must be given very slowly through intravenous injection over a minimum of ٢٠ minutes; it is preferable to be administered as a low volume by intravenous infusion (BNF, ٢٠٠٢).

Side Effects

Headache, nausea, palpitation, dizziness, hypotension and pericardial pain are reported. Persistent emesis, severe restlessness, agitation, gastrointestinal bleeding and cardiac arrhythmias are the side effects associated with plasma concentrations over ٢٠mg/L. Hyperglycemia, hypotension, more life-threatening cardiac arrhythmias, convulsions, permanent brain damage and death may occur at concentrations above ٣٥ mg/L. Individual patients may suffer from these side effects at serum concentrations other than those quoted e.g seizures occurred in patients at ٢٥ mg/L (Gibbs and small, ٢٠٠٣).

Therapeutic Drug Monitoring:

Theophylline has a narrow therapeutic –index and its hepatic metabolism vary between individuals therefore, the serum levels of the drug should be monitored. The samples should be taken at steady state approximately ٤-٦hours after starting the infusion and ٨-١٢hours after an oral dose of modified release product. Serum level should be adjusted between ١٠-٢٠mg/L. However, some patients show clinical responses at levels less than ١٠mg/L others tolerate levels more than ٢٠mg/L.

Only modified release preparations should be used and once the patient is stabilized on a particular product it should not be changed to another because there is differences in serum profiles of different heophylline preparations. Normal-release theophylline preparations should not be used as they show rapid absorption, highly variable clearance, and short and unpredictable duration of action (Gibbs and Portlock ٢٠٠١).

Precautions

It should be used with caution in patients with cardiac disease, hypertension, hyperthyroidism, peptic ulcer, hepatic impairment, epilepsy, also in pregnancy, breast-feeding and elderly. It should be avoided in porphyria.

Drug Interactions

Cimetidine, erythromycin, oral contraceptives, ciprofloxacin and propranolol decrease theophlline metabolism, thus increasing its serum level and toxicity. Carbamazepine, phenobarbitone, phenytoin, sulphinpyrazone increase its hepatic metabolism, thus decreasing its serum level and efficacy.

Dosage

Oral	Adult	٢٥٠-١٠٠٠ mg (modified release) in ١-٢ divided doses.
	Child	١٠-١٢ mg/kg (modified release) in ١-٢ divided doses.

Intravenous Aminophylline dosing in Acute Severe Asthma (BNF, ٢٠٠٢)

	Total daily dosage range	Patient Characteristics
Intravenous Injection	٥ mg/kg as a single dose	Adults and children
Intravenous Infusion	٠,٥ mg/kg/h ١ mg/kg/h ٠,٨ mg/kg/h	Adults Child ٦ months-٩ years Child ١٠ – ١٦ years

IV] Corticosteroids

Pharmacodynamics

They stimulate the synthesis of the protein [lipocortin], which inhibits phospholipase A_2 enzyme activity, eventually inhibits the synthesis of prostaglandins and leukotrienes in macrophages, monocytes and mast cells. They block the production and release of the potent inflammatory cytokines and also the formation of complement C_3 acute phase reactants. They reduce the extravasation of lymphocytes, fibrosis and production of platelet activating factor and IgE. All these effects are combined to decrease the inflammatory damage in the airways and the hyper-reactivity resulting in decreased oedema and secretion of mucus into the airway.

Inhalational therapy with corticosterids is used in asthma prophylaxis, being highly effective in controlling the delayed inflammatory response. Alleviation of symptoms usually occurs ٣-٧ days after starting therapy with a maximal response during ٧-١٤ days or more. They are introduced earlier in the management of asthma if there are significant nocturnal symptoms or more than three wheezy episodes per week or if short-acting β_2-agonists are used more than once daily.

Oral corticosteroids are used as a last resort in chronic asthma to provide adequate control of symptoms. The minimum effective dose must be used to avoid their side effects as far as possible. Their immediate use to abort a severe attack may be invaluable. Prednisolone in doses of about ٣٠-٤٠ mg may be needed initially depending on the severity of symptoms, after the patient being stable, it may be decreased gradually over ٢-٣ weeks to an appropriate maintenance dose or rapidly over a few days, this will depend on the duration and intensity of rescue treatment. The treatment should be continued until the dose reduction does not lead to relapse. Alternate-day dosing is usually unsuitable in asthma because patients tend to deteriorate in the second ٢٤hours period.

Hydrocortisone or methylprednisolone up to ١g daily are administered parenterally in acute severe asthma with change to the oral therapy as the patient improves. Nevertheless, it is reported that oral dosage of ٤٠ mg prednisolone may be of similar efficacy (Gibbs and Small, ٢٠٠٣).

Side Effects

i] Oral Corticosteroids

Mineralocorticoid effects include: hypertension, hypokalemia, muscle weakness, sodium and water retention. These effects are significant with hydrocortisone, slightly occur with prednisolone and methylprednisolone and negligible with dexamethasone and betamethasone.

Glucocorticoid effects include: precipitation of diabetes, osteoporosis, depression, euphoria, peptic ulceration, immunosuppression, Cushing's syndrome, growth suppression in children, worsening of infection, skin thinning, striae a trophic, increased hair growth, perioral dermatitis and acne.

Adrenal suppression occurs with high doses and/or prolonged treatment. Steroid therapy must be gradually withdrawn in these patients to permit recovery from adrenal suppression and the resumption of adequate endogenous cortisol secretion. Adrenal crisis of hypotension, weight loss, arthralgia and sometimes death will result if not withdrawn gradually after prolonged use or high doses.

ii] Inhaled Corticosteroids

Few and minor adverse effects: the most common being mild throat irritation and hoarseness (dysphonia). The oral deposition of drug may sometimes cause oral thrush. These effects are largely prevented by twice daily administration that is effective as that given ٤ times daily; by rinsing the mouth with water or mouthwash after using the inhaler, and using a spacer device. Toothbrushes have been reported to be reservoir of candida infection in patients using inhaled corticosteroids; patients should be advised to change their toothbrush if they develop hoarseness or significant sore throat during treatment. If thrush occurs, it is controlled with topical miconazole or nystatin.

Although adverse systemic effects are unlikely unless the daily dose exceeds ١٥٠٠-٢٠٠٠ ug (higher doses) of inhaled steroids, small increased risk of glaucoma with prolonged high doses of inhaled corticosteroids and cataracts have also been reported.

Nebulized steroids given with facemask may cause facial eczema, this may be largely prevented by coating skin under mask with soft paraffin and washing face after dosing.

Relative Contraindications:

Hypertension, Obesity, Diabetes Mellitus, peptic Ulceration, Psoriasis, Pregnancy, Childhood and intercurrent infection especially tuberculosis.

Drug Interactions:

- Corticosteroids antagonized the effect of antidiabetic agents due to their hyperglycaemic activity.
- Corticosteroids antagonized the effect of antihypertensive drugs.
- Corticosteroids increased risk of hypokalemia with high doses of β agonists.
- Carbamazepine, Phenobarbitone, Phenytoin and Rifampicin reduced steroid effect due to increased metabolism.

Dosage (Inhalation Therapy) For drugs registered in Sudan:

Beclomethasone Diproprionate, Budesonide, Fluticasone (see Table ٢).

V] Cromolyn Sodium and Nedocromil Sodium

Pharmacodynamics

They act by different mechanisms; they inhibit mediators release from mast cells (Pearce *et al*., ١٩٨٩), reverse the increased functional activation in leukocytes and posses the ability to suppress the activating effects of chemotactic peptides on human neutrophils, eosinophils, and monocytes (Murphy and Kelly, ١٩٨٧).

Other reported mechanisms of their action include their inhibition of parasympathetic and cough reflexes (Hargreaves and Benson, ١٩٩٥; Fuller et al., ١٩٨٧); and leukocyte trafficking in asthmatic airways (Hoshino and Nakamura, ١٩٩٧).

Cromolyn and Nedcromil are used as a preventive therapy in mild to moderate asthma but they are ineffective in treating ongoing bronchoconstriction. Nedcromil is more effective than Cromolyn in animal models and human studies (Brogden and Sorkin, ١٩٩٣). There is evidence that regular use for ٢-٣ months reduce bronchial hyper-reactivity (Murphy and Kelly, ١٩٨٧; Hoag and McFadden, ١٩٩١)

Pharmacokinetics

They are given by inhalation (aerosol spray, nebuliser or turbo-inhaler), only ١٪ is absorbed and excreted unchanged in urine and bile equally. Peak plasma concentration occurs within ١٥ minutes of inhalation, and the half-life range from ٤٥ to ١٠٠ minutes.

Side Effects

Side effects are minor and infrequent, they include bronchospasm, cough, wheezing, laryngeal oedema and angioedema. Headache, anaphylaxis, joint pain and swelling, rash, nausea and bad taste are also reported. These reactions reported at frequency of less than ١ in ١٠،٠٠٠ patients ((Murphy and Kelly, ١٩٨٧).

Dosage

Sodium Cromoglycate

Aerosol Inhalation: Adult and Child ١٠ mg (٢ puffs) ٤ times daily increased in severe cases or during periods of risk ٦-٨ times

Nedocromil Sodium

Aerosol Inhalation: Adult and child over ٦ years ٤mg (٢ puffs) ٤ times daily, when control is achieved may be reduced to twice daily.

VI] Leukotrienes Modifying Drugs

Pharmacodynamics

These drugs act by two different mechanisms:

i] Leukotriene –receptors antagonists e.g., Montelukast and Zafirlukast. They are selective, high affinity, competitive antagonists of cysteinyl leukotrienes receptors (cys-$LT_١$) (Krell *et al*., ١٩٩٠; Johnes *et al*., ١٩٩٥). Cysteinyl leukotrienes are potent bronchoconstrictors including $LTC_٤$ $LTD_٤$, and $LTE_٤$.

ii] Leukotrienes – synthesis inhibitors e.g., Zileuton, which is a potent selective inhibitor of ٥-lipoxygenase enzyme that produce leukotrienes from arachidonic acid.

These drugs are not indicated for rapid bronchodilator therapy, so the patients are instructed to have their available rescue medications such as $\beta_٢$-agonists. They are used in prophylactic treatment of mild asthma but their role in moderate and severe asthma is not adequately assessed yet. Some clinical trials have demonstrated that the use of Leukotriene antagonists allow reduction of the dose of inhaled steroid needed for control of asthma exacerbations (Lofdhal *et al*., ١٩٩٩; Jarvis and Markham, ٢٠٠٠).

Pharmacokinetics

These drugs are available for oral administration in tablets form and they are rapidly absorbed.

Zafirlukast has bioavailability greater than ٩٠٪and it is over ٩٩٪ protein bound. It is metabolized by the liver cytochrome $P_{٤٥٠}$ isozyme $CYP٢C_٩$; it is half-life is approximately ١٠ hours.

Montelukast has bioavailability ٦٠-٧٠٪ and its protein binding approach ٩٩٪. It is metabolized by the liver cytochrome $P_{٤٥٠}$ isozyme $CYP٣A_٤$ and $CYP٢C_٩$ and its half-life between ٣-٦hours.

Zileuton extensively metabolized by cytochrome $P_{٤٥٠}$ isozymes and by UDP-glucronosyltransferases, it is short acting with half-life of ٢,٥ hours (Joel and Lee, ٢٠٠١).

Side Effects

Montelukast and Zafirlukast may cause in very rare instances systemic eosinophilia and vasculitis similar to Churg -Strauss syndrome. Zileuton may cause elevation of liver enzymes in the first two months of therapy.

Drug Interactions

- Aspirin increases the plasma concentration of zafirlukast.
- Erythromycin, terfenadine, phenobarbitone, theophylline reduce the plasma concentration of zafirlukast.
- Zafirlukast enhances warfarin effect.
- Zafirlukast possibly increases plasma theophylline concentration.

Dosage

Montelukast: Adults (١٠ mg daily at bed time); Child (٢-٥ years: ٤ mg daily at bed time; ٦-١٤ years ٥mg daily at bed time).
Zafirlukast: Adults (٢٠ mg twice daily); Child (under ١٢ years not recommended).

١,٣ Pharmaceutical Care

١,٣,١ Evolution of the Pharmaceutical Care Concept

The philosophy of pharmaceutical care is now accepted worldwide as the primary mission of pharmacy. It was first generated by clinical pharmacists in the United States of America (USA) to describe the patient-oriented services that the pharmacist should offer. Clinical pharmacists provide pharmaceutical care through using all their knowledge and skills to benefit the patient, over a course of time. This level of care and work with patients is beyond the traditional pharmacist-patient interaction. It reaches beyond the training received in many faculties of pharmacy, which have not updated their undergraduate curriculum to cope with the re-professionalization of the pharmacist. Pharmaceutical care is an informational partnership between patients and pharmacists; it ensures the achievement of the patient's desired health care outcomes through a collaborative process with physicians and other health care providers, and provides patients with better understanding of their health status and drug therapy so they can take better health informed decisions.

In ١٩٨٦, a publication entitled *Drugs Don't Have Doses-People Have Doses!*, Cipolle defines the role of the pharmacist as a "*clinical problem solver*". In ١٩٩٠, Hepler and Strand defined pharmaceutical care as "*the responsible provision of drug therapy for the purpose of achieving definite out comes that improve a patient's quality of life*". In ١٩٩٣, the American Society of Health-System Pharmacists (APhA) statement provided an adaptation of the definition developed by Hepler and Strand and defined pharmaceutical care as "*The mission of the pharmacist is to provide Pharmaceutical care, which is the direct, responsible provision of medication-related care for the purpose of achieving definite outcomes that improve a patient's quality of life*"

The following are principle elements of pharmaceutical care: -

i] It is medication related: it involves not only the actual provision of medication but also decisions about medication use for individual patients. As appropriate, this involves decisions not to use medication therapy as well as judgments about medication selection, dosages, routes, and methods of administration, medication therapy monitoring, and the provision of medication-related information and counseling to individual patients.

ii] It is care that directly provided to the patient: overall patient care consists of integrated domains of care including medical care, nursing care, and pharmaceutical care. Health professionals in each of these disciplines possess unique expertise and must cooperate in the patient's overall care. Through pharmaceutical care, the pharmacist contributes unique knowledge and skills to ensure optimal outcomes from the use of medications. The pharmacist cooperates directly with other professionals and the patient

in designing, implementing and monitoring a therapeutic plan intended to produce definite therapeutic outcomes that improve the patient's quality of life.

iii] It is provided to produce definite outcomes; the medication-related therapeutic outcomes sought are cure of a patient's disease, elimination or reduction of a patient's symptomatology, arresting or slowing of a disease process, and preventing a disease or symptomatology (Oddis, ١٩٩٢). This, in turn, involves three major functions: [١] identifying potential and actual medication-related problems, [٢] resolving actual medication-related problems, and [٣] preventing potential medication-related problems. A medication-related problem is an event involving drug therapy that is actually or potentially affecting the optimum outcome for a specific patient. The medication related problems include, untreated medical problem, inappropriate drug selection, subtherapeutic dosage, over dosage, failure to receive medication, adverse drug reactions, drug-interactions and the use of medication without a valid indication (Helper and Strand, ١٩٩٠).

١,٣,٢ **Barriers to Pharmaceutical Care Implementation** (Rovers *et al.*, ١٩٩٨)

Several articles have been published about barriers that impede the implementation of pharmaceutical care in a variety of settings, these include

I] Attitudes of Pharmacists:

Unfortunately, some pharmacists do not accept the due to lack of confidence in their abilities and fear of change to incorporate the concept into their practice. Others have misconceptions that patients will not accept this type of care and that it will create problems with other health care providers. The obstacle of fear can be overcome through believing in their knowledge and skills, and the adoption of "a one patient at a time" philosophy, this will allow them to develop the skills and knowledge overtime, and to build a pharmaceutical care practice with confidence. When pharmacists offer services that satisfy patients's need, overtime, patients will realize the benefits of pharmaceutical care and will tell others. Studies proved that when pharmacists focus on establishing professional relationships with other health care providers, the potential for hostility subsides.

II] Lack of Advanced Practice Skills

Many of the current practitioners lack the advanced practice skills in therapeutics, clinical problem solving, communication, documentation and research. Pharmacists must feel confident about the skills they already have and exert effort into building those that are weak. Pharmacists must expand their therapeutic knowledge that may be achieved through programs offered by faculties of pharmacy and accredited continuing education providers. Development of an increased understanding of therapeutics

and drug information skills with appropriate training and practice will make clinical problem solving less difficult and a natural process. Participating of pharmacists in educational programs on interpersonal communication will provide the pharmacist with strong communication skills to elicit key information from patients and to explain and promote the pharmaceutical care concept to patients and other health care providers. Documentation systems provide a systemic review of the patients' health status and drug therapy and help pharmacists to provide optimal care of their patients.

III] Resource-Related Constraints

Lack of time to provide pharmaceutical care has been reported by some pharmacists. In reality, pharmacists lack time due to the fact that they focus on the wrong activity. A certain amount of time could be routinely scheduled for patient care activities, even if it is just a fraction of each day. Several studies reported that implementation of pharmaceutical care saves time and increase the profitability of the pharmacy. Financial concerns that a lot of money is necessary to redesign the pharmacy, hire more personnel, and purchase computer or documentation system were reported as other obstacles. Pharmaceutical care is not the physical environment or the computer software, it is a philosophy that focuses on interaction with patients, pharmacists can plan changes at a minimal cost by employing good money management habits to add personnel or documentation system when needed.

IV] System-related Constraints

The most real and difficult obstacle to be overcome is reimbursement. It will be financially unfeasible for most, if not all pharmacists to provide pharmaceutical care over long term without some type of payment. Other obstacle is the reluctance of some patients to spend additional time with the pharmacist because they are unfamiliar with the pharmacist's expertise, in addition they believe that pharmacists are invading their physician's terrority and they do not want to anger their physician. The key reason that why patients do not demand pharmaceutical care is that they do not understand the concept. Thus, pharmacists need to launch a major public relations and education campaign to change the expectations of patients and create a demand. A temporary obstacle to the implementation of pharmaceutical care is that not all health care providers will appreciate pharmacists as patient care providers and see no value in pharmaceutical care. Pharmacists must demonstrate their willingness to be responsible for the patient's drug therapy and must develop close working collaboration with other health care professionals and provide well-thought rational drug therapy recommendations to physicians. The acceptance of pharmaceutical care by patients, physicians and administrators will be hard due to the lack of research proving its value to society. Practitioners, administrators and schools of pharmacy need to coordinate their activities to report research outcomes that provide evidence.

V] Academic and Educational Obstacles

Faculties of pharmacy must examine their undergraduate curriculum closely, and gain an understanding of pharmaceutical care, as it exists today, as well as its evolvement in the future. This understanding will allow the faculties to show students how pharmaceutical care can fit into the pharmacy practice as a whole. The movement to a student-centered curriculum with emphasis on small group discussions, problem solving activities, patient cases and problem-based learning techniques will help students grasp pharmaceutical care concepts. Students must interact with patients and other health care professionals earlier in their training to increase their understanding of the health care system and improve their skills and attitudes.

Many pharmacy students who have become aware of pharmaceutical care express disappointment about the lack of experts to follow in providing this care in practice; fortunately this is a temporary obstacle. Faculties of pharmacy can help in rectifying this problem through supporting innovative practitioners who provide direction and input to the faculties and develop mentoring relationships with students.

١,٣,٣ Evaluation of the Pharmaceutical Care Services

Numerous studies have demonstrated that pharmaceutical care services have a significant impact on the health care management and health care expenses in the long-term. Pharmacists prevented many drug related problems such as hospitalizations, adverse drug events and deaths. Clinical pharmacy services that are provided in both hospital and community pharmacies include dosage adjustments for patients with certain health conditions, dosage conversion form intravenous route to oral route, patient counseling, development of care plans, monitoring drug therapy, making rounds on medical units, giving vaccines and providing smoking cessation programs (Schumock *et al*., ١٩٩٩).

Over the years, many drug related problems have resulted in a decrease in patients' quality of life, an increase in health care costs, and an increase in mortality rates. The annual costs for drug related illness and deaths in the United States of America was estimated to be $٧٦,٦ billion dollars (Johnson and Bootman, ١٩٩٧). Several studies reported that pharmacists practicing pharmaceutical care have prevented or resolved drug related problems, reduced the inappropriate prescribing, enhanced the management of the disease, and improved the medication compliance and patients' knowledge, and reduced the total medical cost for each patient without adversely affecting health-related quality in patients. (Watanabe *et al*., ١٩٩٨; Smythe *et al*., ١٩٩٨; Taylor *et al.,* ١٩٩٨; Asheville project, ١٩٩٨; Munore *et al.*, ١٩٩٧; Cipolle *et al*., ١٩٩٨).

١,٤ Asthma in Sudan

There is a lack of information about the prevalence of asthma in Sudan, table ٢ shows the available statistical data as obtained from the Ministry of Health. Studies about asthma are very few in Sudan, in ١٩٩٦, Elhag and Omer carried out a study about the prevalence of nocturnal cough and its relation to asthma in Sudanese school children. Their results showed a high prevalence rate of nocturnal cough in school children, which was highly suggestive of asthma, and they were likely to benefit from asthma drug therapy.

Table ١,٢: Prevalence of Asthma as provided by Ministry of Health

Year	Cases	Death	Percentage of death
١٩٩٨	٤٠١١	٤٠	٠,٩
١٩٩٩	٢٧٧٢	٦٩	٢,٤
٢٠٠٠	٤٧٨٤	٢٠٦	٤,٣
٢٠٠١	٧٣١٩	٦٨	١

The urban and rural differences in asthma symptoms among ١٤-١٩ years old students was studied by Abuobeida (٢٠٠١). The study revealed that the prevalence of asthma and wheeze were significantly higher in urban than in rural areas and the severity of asthma increased with urbanization, it also showed the under diagnosis and under treatment of the disease.

Asthma is increasing all over the world particularly in developing countries such as Sudan. Major questions for researchers will arise such as is there an evidence that asthma is being appropriately treated in Sudan; is there evidence that asthma is treated according to the national or international guidelines; is there evidence that the asthmatic patients are provided with the best health care, is the contribution of the pharmacists in asthmatic patients care with other health team members will improve their outcomes. From these questions the objectives of this research work were developed.

١,٥ Objectives of the Present study

It was reported that patients with asthma were associated with a high frequency of drug related morbidity (National Heart, Lung and Blood Institutes of Health, ١٩٩٢). Prescribing practices at ٢٠ health centers and two teaching hospitals in Khartoum state were described as poor and illogical (Awad, ١٩٩٩; Himad, ٢٠٠٤). There are no reported studies that have evaluated the quality of prescribing practices for asthmatic patients in Sudan. This study was designed to investigate the current prescribing practices for patients with chronic asthma and acute attacks of asthma.

The overall research hypothesis was that implementing pharmaceutical care services for asthmatic patients could improve their health status, and cost-effectiveness of their drug therapy. This hypothesis was tested through implementation and evaluation of the pharmaceutical care services in a one year controlled study.

The objectives of the present study include: -

١. Investigation of the current prescribing practices for the treatment of chronic asthma

٢. Investigation of the current prescribing practices for the management of acute attacks of asthma.

٣. Implementation and evaluation of the impact of pharmaceutical care service in Sudanese asthmatic patients.

Chapter ٢

Investigation of the Current Prescribing Practices for the Treatment of Chronic Asthma

٢,١ Introduction

٢,١,١ Background to the Prescribing Practices

The prescribing of medicines is an integral part of the health service; without its hazards it is relatively safe, effective and inexpensive mode of therapy. Drug utilization focuses mainly on the quantity and availability rather than the quality of prescribing. Good quality of prescribing must be a part of indicators for assessing the quality of patients' care (Williams, ٢٠٠٢).

Prescribing errors on general practice prescriptions are common. Error is defined as " *the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim*". Errors can occur in all the stages of the care process, from diagnosis to drug administration, including incorrect prescribing, inadequate information given by the prescriber or the pharmacist to the patient, and incorrect use of medicines by the patient. All can cause suffering of the patient and increasing the cost of care. Careful checking of the prescriptions by the pharmacist reduce patients' harm (Nadeem *et al*., ٢٠٠١).

A study about prescriptions errors in three Sudanese paediatric hospitals (Omdurman, Ahmed Gasim and Albuluk) revealed that the percentage of prescriptions errors was too high indicating poor prescribing practices. (Khalafalla *et al.*, ٢٠٠٣). In ٢٠٠١, Awad *et al* reported poor prescribing practices in ٢٠ health centers at Khartoum-state.

These results showed the need for an effective and continuous in-service training of prescribers and dispensers. The study recommended the introduction of the clinical pharmacy services in all hospitals.The persistence of uncontrolled asthma remains a serious problem world-wide, the major factors that contribute to this include the inappropriate prescribing that leads to ineffective management, in addition to patient non-compliance, and lack of knowledge and skills on the parts of patients and health care professionals (Larsen and Hansen, ١٩٨٥; Synder *et al*., ١٩٨٧; WHO, ١٩٩٥; Herborg *et al*., ٢٠٠١).

The possible differences between the high and low quality of asthma prescribing practices in the Bradford Health Authority was investigated and researchers suggested the use of the ratio of preventors to bronchodilators (P: B) as an indicator of asthma prescribing, they found low quality practices due to the with low ratios of P: B and recommended that joint initiatives for disease management of asthma should initially focus on these practices with low P: B (Salamzadeh *et al.,* ٢٠٠٠). In ٢٠٠٢, Williams used the ratio of inhaled corticosteroids to bronchodilators as one of the prescribing indicators for asthma.

٢,١,٢ Treatment of Chronic Asthma

Table ٢,١shows the stepwise guidelines for the management of chronic asthma in adults and children as recommended by The British Thoracic Society in ١٩٩٧. Inhalation is the preferable route of administration as it allows the drugs to be delivered directly to the airways thus reducing the required dose and side effects. The choice of an inhalation device and assessment of patient's inhaler technique are important steps in treatment of asthma. Infrequent attacks are managed when occur but the more frequent attacks require preventive therapy and stepwise progression in treatment is always preferable.

The treatment should be started at most appropriate step to the initial severity. The rescue course of prednisolone may be required at any step to achieve early control of the condition and then the treatment should be reduced. The treatment should be reviewed every ٣-٦ months; stepwise reduction may possible if the control is achieved. If the treatment is started at step ٤ or ٥ or contained corticosteroids tablets, the reduction may be after short interval. In others a ١-٣ month or longer time of stability is required before the therapy is stepped down slowly (BNF, ٢٠٠٢).

Table [٢،١]: Guidelines for the management of chronic asthma in adults and children as recommended by The British Thoracic Society in ١٩٩٧.

Step	Treatment type	Recommended drugs and doses
١	Occasional use of relief bronchodilators	Inhaled short acting β_2 agonists as required, if needed more than once daily, move to step ٢
٢	Regular inhaled anti-inflammatory agents [preventer therapy]	Inhaled short acting β_2 agonists as required plus inhaled standard-dose steroid* Alternatively use cromoglycate or nedocromil sodium, but if control is not achieved start inhaled steroids
٣	High dose inhaled steroids or standard- dose inhaled steroids plus long acting inhaled β_2 agonists bronchodilator	Inhaled short acting β_2 agonists as required plus inhaled high-dose steroids† (via a large volume spacer) In patients who experience side effects with high dose steroids the following can be added to standard- dose inhaled steroids* i] Salmeterol ٥٠μg twice daily or formoterol ١٢ μg daily in those >١٨ years or ii] Sustained release theophylline or iii] Cromoglycate or Nedocromil may also be tried
٤	High dose inhaled steroids and regular bronchodilators	Inhaled short acting β_2 agonists as required with inhaled high-dose steroid† (via a large volume spacer) plus a sequential therapeutic trial of one or more of the following: inhaled long acting β_2 agonists, sustained release of theophylline inhaled ipratropium or oxitropium, long acting β_2 agonists tablets high dose inhaled bronchodilators, cromoglycate or nedocromil
٥	Regular Steroid Tablets	Inhaled short acting β_2 agonists as required with inhaled high-dose steroid† (via a large volume spacer) and one or more long-acting bronchodilators plus regular prednisolone tablets as a single daily dose.

** Standard--dose inhaled corticosteroid (based on delivery via a metered dose inhaler [MDI]) = budesonide or beclomethasone ١٠٠-٤٠٠ μg twice daily or fluticasone ٥٠-٢٠٠μg twice daily*

† High-dose inhaled corticosteroid (based on delivery via MDI) = budesonide or beclomethasone ٨٠٠-٢٠٠٠ μg daily or fluticasone ٤٠٠-١٠٠٠ μg daily

٢,٢ Method

٢,٢ ١ Study Area:

Shaab teaching hospital is one of the major teaching hospitals in Sudan, it is located in Khartoum state. The hospital medical units are neurology, neurosurgery, chest and cardiology, and cardio thoracic Surgery. It contains about ١٠ wards, ٢ intensive care units, ٢ intermediate care units, ١ intensive coronary care unit, ١ intermediate coronary care unit, ١ asthma care unit and ١ emergency department for both chest and cardiology. It also contains The National Center of Cardiology and the National Center of Neurosurgery. The hospital contains about ١٦٠ beds and served approximately ٤٨٠ inpatients per month.

This study was conducted in one of the largest teaching hospitals in Sudan due to the important role of the teaching hospitals in teaching and training of our health care providers and the fact that they also provide health services to a large number of the population, there is a need for research work to assess the drug use patterns in the teaching hospitals in Sudan.

٢,٢,٢ Inclusion and exclusion criteria

Patients' encounters to be included were chronic asthmatics encounters prescribed for asthmatic patients attending the out patient clinic. Samples were taken from adults. The in-patients prescriptions were excluded.

٢,٢,٣ Study Design and Sampling Strategy

This is a descriptive, quantitative and cross-sectional hospital based survey to investigate the prescribing practices for the treatment of chronic asthma. The sample size was determined according to the WHO recommendation that a minimum of ١٠٠ samples per facility should be collected for the assessment of prescribing practices. Thus, a sample size of ١٢٥ prescriptions was collected randomly.

Systematic sampling was used for data collection

١. Sampling interval = Total number of prescriptions collected / Number of prescriptions to be included in the sample

٢٠٠/١٢٥ = ١,٦

٢. The random number had been chosen from the standard random table was multiplied by the sampling interval; the result was rounded up to get the number of first prescription.

١,٦ x ٠,١٨٣ = ٠,٢٩, which was rounded up to ١, so the first prescription was chosen for the sample, then other prescriptions selected by adding the sampling interval to the previous result, the first result was ٠,٢٩ then the next prescriptions selected were as follows

٠,٢٩ --- ١

٠,٢٩ + ١,٦ = ١,٨٩ prescription number ٢

١,٨٩ + ١,٦ = ٣,٤٩ prescription number ٤

٣,٤٩ + ١,٦ = ٥,٠٩ prescription number ٥

٥,٠٩ + ١,٦ = ٦,٦٩ prescription number ٧

٦,٦٩ + ١,٦ = ٨,٢٩ prescription number ٩ and so on

٢,٢,٤ Data Collection

١٢٥ prescriptions for the treatment of chronic asthma were collected prospectively due to inadequate sources of retrospective data. Data was collected during the period from February to October ٢٠٠٣ to include different days and times, to ensure that data is comprehensive (representative data) and to enhance its validity and reliability.

The indicators that were used to assess the prescribing practices for the treatment of chronic asthma include

i] The percentage of prescription including all the basic necessary information (date, name of patient, age of patient, diagnosis, strength of drug, directions for use, quantity of drug to be dispensed, and signature of the prescriber).

ii] Number of drugs prescribed per prescription.

iii] Percentage of prescriptions with drug-drug Interactions.

iv] Percentage of inhaled steroids prescribed.

v] Percentage of oral steroids prescribed.

vi] Percentage of inhaled bronchodilators prescribed

vii] Percentage of oral bronchodilators prescribed

viii] Percentage of antibiotics prescribed

٢,٢,٥ Data Analysis

Data were entered and analyzed using templates created in Microsoft Excel version ٢٠٠٠.
Results are presented in tables.

٢,٢. ٦. Pilot test:

A pilot study of data collection, data entry and analysis was conducted on ١٠ prescriptions prior to the study to ensure validity and reliability of the methodology of data collection and the results of the study. Prescriptions used in the pilot test were excluded from the study sample.

٢,٣ Results and Discussion

Table ٢,٢ shows the results of evaluating the issued prescription for the inclusion of the basic necessary information. The results revealed that all collected prescriptions were without age and diagnosis. The diagnosis is necessary to ensure the appropriate selection of drug therapy. The date was not written in ٨٣,٧٪ of them. The date on which the prescription was issued is required to confirm the period of validity of the prescription, moreover, it is very crucial as a lot of Sudanese patients used to refill their prescriptions for long time without checking with their physicians particularly those with chronic diseases such as asthma in which the monitoring of the patients condition and stepping of treatment are very important.

The name of the medicine was not clearly written due to bad handwriting or spelling mistakes in ٣٢٪ of the prescriptions. In, ٢٠٠١,Nadeem *et al* reported that hand written prescriptions lead to a higher rate of prescribing errors. The strength of the drug and the quantity to be dispensed were not shown in ٦٨٪ and ٨٠,٨٪ of the prescriptions, respectively. The dosage form and the directions for use were not written in ٣,٢٪ and ٤٪ of the prescriptions, respectively. The strength of the drug specifies the concentration of the dosage form, the quantity of the drug to be dispensed verifies the duration of treatment and the directions to use the drug identify how often to be taken and any specific instructions and warnings. The missing of any one of these dosing specifications may lead to irrational utilization such as their use in subdoses, overdoses and for inadequate duration. Prescribers did not sign ٤١,٦ % of the prescriptions, and in those, which were, signed ٧٨,١٪ of them were with unclear signature. None of the prescriptions shows clearly the doctor's name and his/her qualification (house officer, medical officer, registrar or consultant).

Table ٢,٢: Evaluation of the prescriptions for their inclusion of the basic necessary information

Basic Necessary Information	Number of Prescriptions	Percentage of Prescriptions
Date	٢١	١٦,٦
Age	٠	٠
Diagnosis	٠	٠
Clear handwriting of drugs	٨٥	٦٨
Quantity to be dispensed	١٥	٣٢
Dosage form of the drug	١٢١	٩٦,٨
Directions to Use of the drug	١٢٠	٩٦
Signature of the prescriber	٧٣	٥٨,٤

The present results revealed that the minimum information required to be in the prescription was missed in many of the prescriptions. There is no global standard for prescription; every country has its own

standards for the minimum information required for a prescription. Prescription should be legible and indicate accurate diagnosis and what should be given; additionally if the prescription includes the following information, not much can be a failure: date on which the prescription was written, name of the patient, Strength of the drug, quantity of the drug to be dispensed to the patient, direction to use (should contain the amount of drug to be taken, the frequency and the route of administration) and signature of the prescriber. Every prescription should indicate the above listed basic data (De Vries *et al*, ١٩٩٤).

Table ٢,٣ shows the results of evaluating the prescribing indicators, in ٦٩,٦٪ of the prescriptions the number of drugs prescribed were in the range of ١-٢ drugs / prescription, while three and four drugs were prescribed in ٢٤٪ and ٦,٤٪ of the prescriptions, respectively. The most favorable average number of drugs per encounter should be less than ٢ (Hogerzeil, ٢٠٠٢). It was reported that the drugs related problems are directly proportional to the number of drugs per prescription but this may not be the rule in asthma, as many patients need more than one drug for controlling their disease. However this study identified the favorable number of drugs prescribed per encounter, the reason behind this may be possibly related to the patient's inability to meet the drug expenses and the fact the prescribers do consider the economical status of the patients, or may be due to a good selection of drug therapy according to accurate diagnosis and the patient current health status but not symptomatic treatment.

Potential drug -drug interactions through prescribing of erythromycin and theophylline were identified in ١,٦٪ (٢) of the prescriptions. Drug disease interactions were ٠٪. Inhaled steroids and inhaled plus oral steroids were prescribed for ٢٤,٨٪ and ٤,٨٪ of the patients, respectively. Oral steroids were prescribed for ٣٢٪ of the patients. The dose of inhaled steroids was written appropriately in ١٣,٥٪ of the prescriptions. Oral steroids dose was inappropriate in ١٥,٢٪ of the prescriptions. Theophylline was prescribed for ١٨,٤٪ of the patients. Oral, inhaled and oral plus inhaled β_2-agonists were prescribed for ١٦٪, ٢٨,٨٪, and ١,٦٪ of the patients respectively. The specific dose was not written in any of the prescribed inhaled β_2-agonists while ٥٤,٥٪of the oral β_2-agonists doses were inappropriate. . The ratio of inhaled corticosteroids to bronchodilators in asthmatic patients may be used as prescribing indicator for quality of prescribing (Williams, ٢٠٠٢). Salamzadeh *et al* (٢٠٠٠) studied the prescribing practice in asthma and they reported that practices of low preventor to bronchodilators prescribing ratio were practices of low quality. In this study, the ratio of using inhaled steroids to bronchodilators was ١: ٢,٦ [٢٤,٨٪: ٦٤,٨٪] indicating prescribing practices of low quality.

Antibiotics were prescribed in ٣٥,٢٪ of the prescriptions, ٧٧,٢٪ of the prescribed antibiotics was erythromycin, others prescribed antibiotics include penicillins, cephalosporins and azithromycin. This illustrates that the antibiotic of choice for asthmatics patients with infections is erythromycin, due to the fact that diagnosis was not indicated in the prescription, it would not be possible to judge on the appropriateness of erythromycin selection. The overall resistance of micro-organisms to antibiotics was reported by Sid Ahmed (١٩٩٥) to be high and that the selection of drug resistance has been associated

with the increase in the irrational use of antibiotics in Sudan. A study conducted in health centers in Khartoum state revealed that the percentage of encounters prescribed with an antibiotic was ٧٣٪ with an inappropriate dose and duration of therapy for children and adults of ٧٧٪ and ٥٨٪, respectively, ٦٠ % of the prescribed antibiotics was amoxicillin and ٨٪ erythromycin (Awad *et al*., ٢٠٠١). A recent study in ٢٠٠٤ reported that the average percentage of antibiotic prescribed in Omdurman and Khartoum teaching hospitals was ٦٥٪ (Himad, ٢٠٠٤). The antibiotic prescribing in Sudan is very high when compared to that recommended by Hogerzeil, ٢٠٠٢ to be less than ٣٠٪. The inappropriate increase in the prescribing of the antibiotics would favour the development of antibiotic resistance, increase in the incidence of serious side effects together with waste of resources leading to increased costs

Factors underlying the described current prescribing practices were unknown, In ١٩٩٩, Awad *et al,* reported that the major factors that influenced prescribing practices in the health centers were the lack of pharmacotherapeutic knowledge and the patients' demand.

Table ٢،٣ Results of the Prescribing Indicators

Indicator	**Number of Prescriptions**
Steroids • Inhaled Steroid • Oral steroids • Inhaled Steroid + oral steroids	 ٣١ ٤٠ ٦
Theophylline	٢٣
$B_{٢}$- agonists • Inhaled $\beta_{٢}$-agonist • Oral $\beta_{٢}$-agonist • Inhaled+ Oral $\beta_{٢}$-agonist	 ٣٦ ٢٠ ٢
Antibiotics • Erythromycin • Penicillins • Cephalosporins • Azithromycin	٤٤ ٣٤ ٥ ٣ ٢

٢,٤ Conclusion and Recommendations

The prescribing practices at the teaching hospitals are expected to be of good quality, since they provide a significant role in teaching and training of health care providers and the fact that they also provide health services to a large number of the population. In reality, many studies world-wide indicated that some of their prescribing practices are of poor quality. The results of this study pointed out the common prescribing errors in the prescribing practices for the treatment of chronic asthma.

Qualitative methods should be designed and implemented to identify the causes underlying the problems identified by this study. Interventional methods such as continuing medical education, establishment of updated national guideline for management of asthma may be effective in improving the prescribing practices.

Continuous collaboration between the pharmacist and the physicians should be established since it is quite necessary for providing health care of better quality to the patient. The prescription should contain all the necessary basic data that will enable the pharmacist to participate in the decision-making of its appropriateness. The well-trained pharmacists continue to have important role in checking prescriptions and encouraging prescribers to good prescribing practices for improving quality of care. Good communication between health care professionals should be encouraged since it is of great value in improving the quality of prescribing and patients' care.

Chapter ٣

Investigation of the Current Prescribing Practices for the Management of Acute Attacks of Asthma

٣,١ Introduction

٣,١,١ Clinical Features of Acute Attacks of Asthma

Acute exacerbations of asthma may be presented as uncontrolled asthma with the following clinical features: normal speech, pulse less than ١١٠ beats/minute, Respiratory rate less than ٢٥ breaths/minute and a peak expiratory flow (PEF) of greater than ٥٠٪ of predicted or best value. It may be easily managed in the community by general practitioners through the use of nebulized β_2-agonist (salbutamol ٥mg or terbutaline١٠mg) then the response is monitored after ١٥-٣٠ minutes of nebulization, if PEF is ٥٠-٧٥٪ of predicted or best value, the patient is given oral prednisolone and usual treatment stepped up, but if PEF >٧٥٪ of predicted or best value then the usual treatment should be stepped up. Patient then should be monitored for symptoms and provided with self-management plan (British Thoracic Society, ١٩٩٧).

Acute severe asthma requires prompt referral to hospital and its management depends on the severity of the attack and its response to treatment .The patient' past history and present drug therapy use are important to be considered. The aims of treatment are to prevent any deterioration in the patient's condition and to fasten recovery .The clinical features of acute severe asthma include inability to complete sentences in one breath during speech, pulse >١١٠ beats/minute, respirations >٢٥ breaths/minute and PEF ≤ ٥٠٪ of predicted or best. Clinical features of life threatening asthma include silent chest**,** cyanosis or feeble respiratory effort, bradycardia or hypotension, and exhaustion, confusion or coma. PEF <٣٣٪ of predicted or best. Patients with severe or life threatening attacks may not be distressed and may not have all above mentioned abnormalities, the presence of any should alert the physician (Gibbs and Small, ٢٠٠٣).

٣,١,٢ Guideline for the Management of Acute Severe Asthma in Adults (British Thoracic Society, ١٩٩٧)

I] Immediate Treatment

- Oxygen ٤٠-٦٠٪
- Nebulized salbutamol ٥mg or terbutaline ١٠ mg via an oxygen driven nebuliser.
- Oral prednisolone (٣٠-٦٠mg) or intravenous hydrocortisone ٢٠٠mg or both if very ill and the then the response monitored ١٥-٣٠ minutes after nebulization.
- No sedatives of any kind
- Chest radiograph to exclude pneumothorax

IF LIFE THREATENING FEATURES ARE PRESENT

- Add Ipratropium (٠,٥ mg) to the nebulized β_2 agonist.
- Give intravenous aminophylline (٢٥٠mg) over ٢٠ minutes [Do not give bolus aminophylline to patients already taking oral theophyllines] OR salbutamol or terbutaline ٢٥٠ µg over ١٠ minutes.

II] Subsequent Management

IF PATIENT IS IMPROVING CONTINUE:

- ٤٠-٦٠ % oxygen
- Prednisolone ٣٠-٦٠ mg daily OR intravenous hydrocortisone ٢٠٠ mg ٦ hourly
- Nebulized β_2 agonist ٤ hourly

IF PATIENT IS NOT IMPROVING AFTER ١٥-٣٠ MINUTES:

- Continue oxygen and steroids
- Give nebulized β_2 agonist more frequently, up to every ١٥-٣٠ minutes
- Add ipratropium ٠,٥ mg to nebulizer and repeat every ٦ hourly until patient is improving

IF PATIENT IS STILL NOT IMPROVING GIVE:

- Aminophylline infusion (small patient ٧٥٠ mg/٢٤ hr, large patient ١٥٠٠mg/٢٤hr); monitor blood concentrations if it is continued over ٢٤ hr
- Salbutamol or terbutaline infusion as an alternative to aminophylline infusion.

III] Monitoring Treatment

- Repeat measurement of PEF ١٥-٣٠ minutes after starting treatment
- Oximetery: maintain $Sa_{O_2} > ٩٢٪$
- Repeat arterial blood gas measurements [Measure them initially if $Sa_{O_2} < ٩٢٪$ or patient has any life threatening features]
- Chart PEF before and after giving inhaled β_2 agonists and at least ٤ times daily throughout hospital stay.
- Transfer patient to ICU if there is deteriorating PEF, worsening or persisting hypoxia, or hypercapneia, exhaustion, feeble respirations, confusion, coma or respiratory arrest.

IV] When discharged from hospitals, patients should have:

- Been on discharge medication for ٢٤ hr and have had inhaler technique checked and recorded.
- PEF > ٧٥٪ of predicted or best and PEF diurinal variation < ٢٥٪, unless discharge is agreed with respiratory physician.
- Treatment with oral and inhaled steroids in addition to bronchodilators.

- Own PEF meter and written self-management plan
- GP follow up arranged within one week
- Follow up appointment in respiratory clinic within ٤ weeks
- Also determine reason (s) for exacerbation and admission
- Send details of admission, discharge and potential best PEF to GP.

٣,٢ Method

٣,٢ ١ Study Area:

The study was conducted in Shaab teaching hospital from March to April ٢٠٠٣.More details about the hospital were given in chapter ٢.

٣,٢,٢ Inclusion and Exclusion criteria

Patients' encounters to be included were encounters prescribed for asthmatic patients with acute attacks attending the emergency department. Samples were taken from adult patients.

٣,٢,٣ Study Design and Sampling Strategy

This is a descriptive quantitative cross-sectional hospital based survey to investigate the management of acute exacerbations of asthma. The sample size was determined according to the WHO recommendation that a minimum of ١٠٠ samples per facility should be collected. Thus, sample sizes of ٢٥٠ admission sheets were collected randomly.

Systematic sampling was used for data collection

١. Sampling interval = Total number of admission sheets collected / Number of admission sheets to be included in the sample

١٠٠٠/٢٥٠ = ٤

٢. The random number had been chosen from the standard random table was multiplied by the sampling interval; the result was rounded up to get the number of first admission sheet.

٤ x ٠,١٨٣ = ٠,٧٣, which was rounded up to ١, so the first admission sheet was chosen for the sample, then other admission sheets selected by adding the sampling interval to the previous result, the first result was ٠,٧٣ then the next admission sheets selected were as follows

٠,٧٣ --- ١

٠,٧٣ + ٤ = ٤,٧٣ admission sheet number ٥

٤,٧٣ + ٤ = ٨,٧٣ admission sheet number ٩

٨,٧٣ + ٤ = ١٢,٧٣ admission sheet number ١٣

١٢,٧٣ + ٤ = ١٦,٧٣ admission sheet number ١٧

١٦,٧٣ + ٤ = ٢٠,٧٣ admission sheet number ٢١ and so on

٣,٢,٤ Data Collection

٢٥٠ admission sheets for the treatment of acute attacks of asthma were collected retrospectively. The data collected include different days and times, to ensure that data is comprehensive (representative data) and to enhance its validity and reliability.

The indicators that were used to asses the prescribing practices for the treatment of acute asthma include
i] Evaluation of admission sheets for the following basic necessary information (date, name of patient, age of patient, and residence of the patient).
ii] Evaluation of admission sheets for reporting of the Vital signs for assessment of acute attacks of asthma.
iii] Evaluation of the current drug therapy of acute attacks of asthma in accordance with the BTS and national guidelines.

٣,٢,٥ Data Analysis

Data was entered and analyzed using templates created in Microsoft Excel version ٢٠٠٠.
Data is presented as Figures.

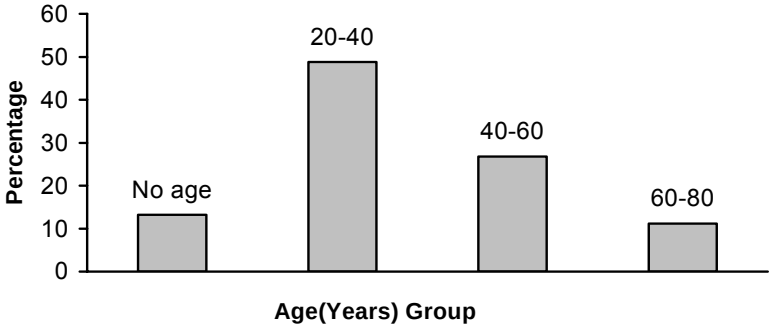
٣,٢,٦ Pilot test:

A pilot study of data collection, entry and analysis was conducted on ١٥ admission sheets, it was carried out prior to the study to ensure validity and reliability of the data collection and the results of the study. Admission sheets used in the pilot test were excluded from the study sample.

٣,٣ Results and Discussion

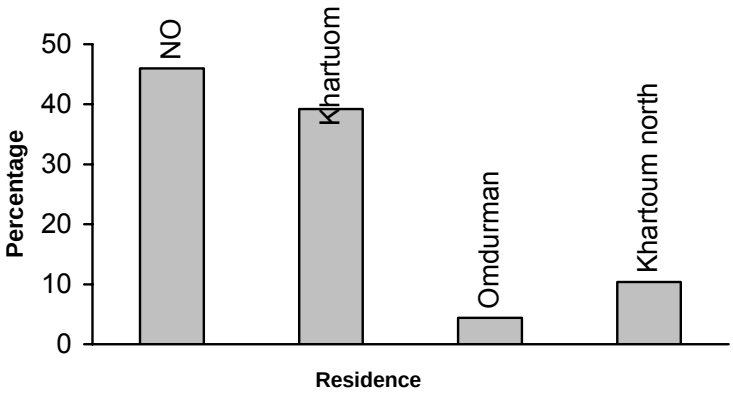
The results of assessing the admission sheets for its inclusion of the demographic data revealed that ٥٦٪ of the admitted patients were males and ٤٤٪ were females, the majority of the patients (٤٤,٨٪) were between the age group of ٢٠-٤٠ years old (figure ٣,١), in ١٣,٢٪ of the admission sheets the ages of the patients were not written. Patients' residence was documented in ٥٤٪ of the patients' admission sheets; the majority of patients were from Khartoum (figure ٣,٢). The demographic data is crucial in the management of patients' diseases as the prescribing of drugs may be influenced by the patients' age and sex in addition to their importance in the documentation of the disease prevalence. Also, the geographical distribution is an indicator for the detection of risk factors associated with asthma in specific areas such as industrial areas or farms. As it was shown in the results that the age and the residence were not written in ١٣,٢٪ and ٤٦٪ of the collected sample, respectively. Such a lack of necessary data may contribute to the non-existence of actual data for the epidemiology of asthma in Sudan.

Figure ٣,١: Distribution of Patients by Age Groups



NO: Age was not written on the admission sheets

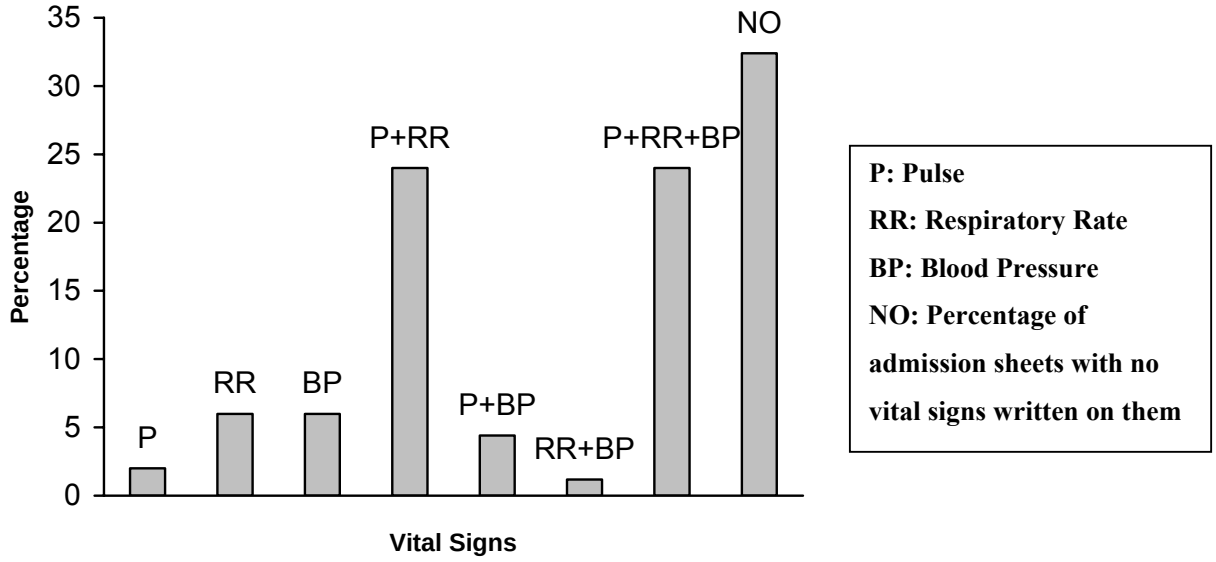
Figure ٣,٢: Distribution of Patients by Residence



NO: Residence was not written on the admission sheets

The results of investigating the admission sheets for the recording of the pulse (P), respiratory rate (RR), blood pressure (BP) measurements have shown that none of the three were recorded in ٣٢,٤٪ of the total collected sample, all of them were recorded only in ٦٠ admission sheets (figure ٣,٣). Peak expiratory flow rate (PEFR) measurement was not recorded in all collected sheets. The full medical history was written in ٤٪ of the sheets. The corner stone in the management of acute exacerbations of asthma is the assessment of the severity of the attack, the main signs (P and RR) and PEFR should be initially assessed and followed up after starting the treatment as recommended by many international guidelines such as the British, Scottish and Egyptian guidelines. The Sudanese manual of asthma stated only that P and PEFR should be assessed .The results of this study showed the lack of reporting these signs in the admission sheets, but it is not known whether they were assessed but not written on the sheet or not being assessed initially. However, if they were done they must be written so as to evaluate their improvement or deterioration during treatment. It was clear from the present results that none of the patients was assessed by PEFR and this may be due to the fact that there are no peak flow meters for use in the casualty. It was found that the full medical history was written only in the admission sheets of ١٠ patients. Appreciation of the patients' past medical history and present treatment is very important in the management of acute asthma (Gibbs and Portlock, ٢٠٠١).

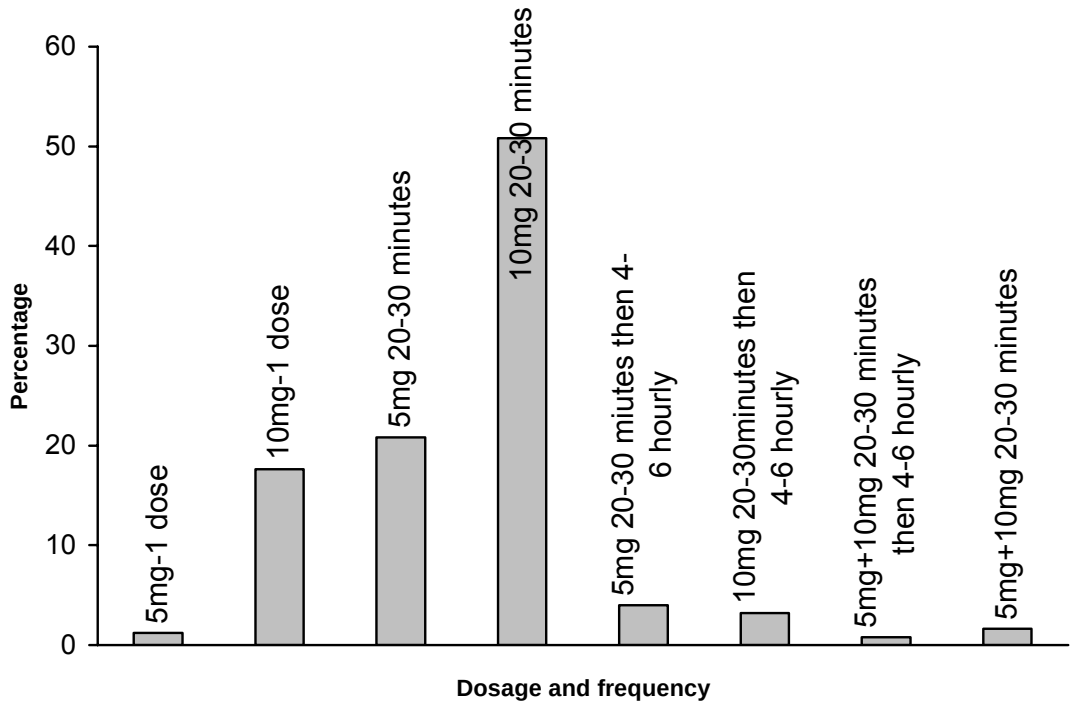
Figure ٣,٣: Percentage of admission Sheets according to Reporting of the Vital signs for Assessment of Acute Attacks of Asthma



The results of evaluating the appropriateness of the management of acute attacks of asthma as written in the admission sheets revealed that oxygen was indicated in ٣٦ (١٤,٤٪) sheets without stating any concentration that should be administered to the patient. It was stated in the BTS guidelines that patients with acute attacks should receive ٤٠-٦٠٪ oxygen, and in the Sudanese asthma manual should receive

٦ litres /minute. Different dosage regimens of nebulized salbutamol with different frequencies of administrations were found in the total collected sample Figure ٣,٤ clearly illustrates the high incidence of deviation from the recommended dose and frequency of administration as recommended by BTS guidelines (table ٣,١,٢). The Sudanese manual stated that ٥mg of nebulized salbutamol should be given every ٢٠ minutes in the first hour followed by a dose every hour till complete response. It was found that the majority of patients did not receive the starting recommended dose ٥ mg. The present results indicated the irrational prescribing of nebulized salbutamol inappropriate dose and frequency of administration, which may lead to increase in the incidence of adverse drug reactions, waste of resources and inappropriate management of the acute attacks of asthma.

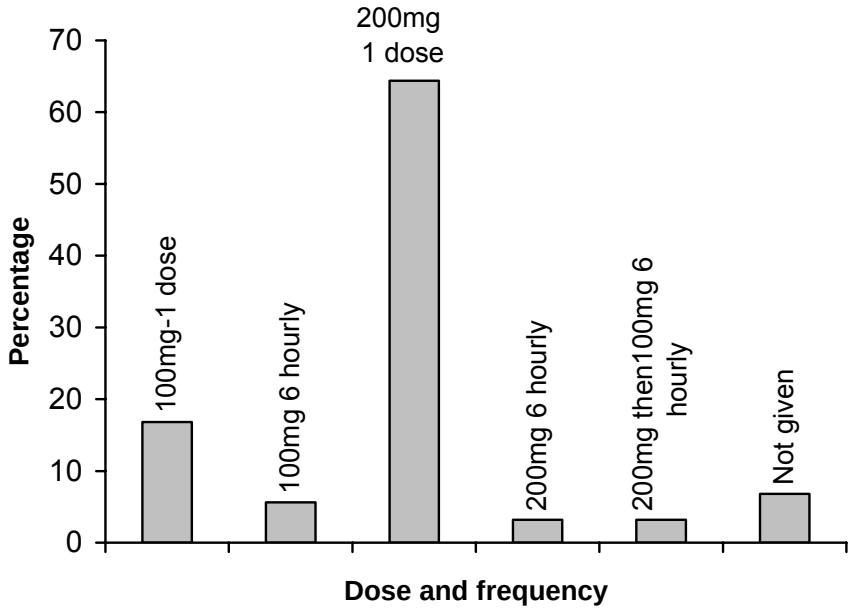
Figure ٣,٤: Percentage of admission sheets with the reported dosage and frequency of administration of nebulized salbutamol



Regarding the prescribing of intravenous aminophylline, it was found in ١٥ (٦٪) sheets to be given as a single dose of ٢٥٠mg and in ٣ (١,٢٪) sheets to be administered as ٢٥٠-mg/٨ hr. In the medical history of present drug therapy, it was not shown whether these patients were already taking oral theophylline or not. This indicates the infrequent use of intravenous aminophylline, which should be the last line of treatment after the failure of salbutamol or terbutaline infusion due to the fact that it is a drug of narrow therapeutic window, which requires therapeutic drug monitoring to prevent its toxicity.

Figure ٣,٥ shows the percentage of admission sheets with the reported dosage and frequency of administration of hydrocortisone. The steroids were prescribed in ٩٣,٢٪ of the admission sheets. Inadequate dose of ١٠٠ mg intravenous (IV) hydrocortisone were found in ٢٥,٤ % of the sheets. The BTS guidelines stated that the patient should receive ٢٠٠mg IV hydrocortisone or ٣٠-٦٠mg prednisolone and Sudan manual recommended ٢٠٠mg ٤ hourly, thus ١٠٠ mg is less than the recommended dosage. Oral prednisolone was prescribed in ٥,٦٪ of the collected sample with a dose of ٣٠ mg. ٦٤,٤٪ of the patients were administered only a single dose of ٢٠٠ mg hydrocortisone not followed by oral prednisolone, this is considered inadequate if the patient is very ill.

Figure ٣,٥: Percentage of admission sheets with the reported dosage and frequency of administration of intravenous hydrocortisone.



As it is demonstrated form the present results that the management of acute attacks of asthma was not following the recommended guidelines in many cases and there was inadequate assessment of the patients and the severity of their attacks. This will contribute to the increased patients visits to the emergency department and the increased cost of care and poor quality of patient care. The lack of updated national guideline for the management of asthma, continued education, supervision and monitoring could be the major factors that contributed to that practice. In addition, the lack of equipments as peak flow meters and those for the measurement of blood gases, therapeutic drug monitoring could be other contributing factors but this should not significantly affect the appropriate assessment and management of asthma to that extent.

٣,٤ Conclusion and Recommendations

The pattern of prescribing practices for the management of acute attacks of asthma was inappropriate indicating the inadequate management of acute exacerbations of asthma.

Well-equipped asthma centers and updated national guideline for the management of asthma should be established. Continuing medical education, supervision and monitoring of the practice of the prescribers particularly the junior medical staff should be encouraged and implemented.

Chapter ٤

Implementation and Evaluation of the Impact of Pharmaceutical Care Service in Sudanese Asthmatic Patients.

٤,١ Introduction

٤,١,١ The Asthmatic Patient Care

The corner stone of management of asthma is the correct use of drugs and patient education. Education of asthmatic patients include three main steps:

a] The patient should understand the action of each of the drugs they use.

b] The appropriate choice of inhalation device(s) should be made and the patient should be educated about their correct use.

c] An individualized self-management plan should be developed for each patient.

Patient counseling will lead to increased patient confidence in ability to self manage asthma; a decrease of hospital admission rates and emergency visits. Improving of the patients' quality of life and increasing in his/her compliance may occur as a result of appropriate patient counseling. Specific counseling on drug therapy should focus on three areas: drugs that used to relieve symptoms; drugs that used to prevent attacks of asthma and drugs given only as reserve treatment for severe attacks (Gibbs and Protlock, ٢٠٠١).

Pharmacists may contribute in asthma care in different ways: -

- Educating Patient about asthma medications.
- Instructing patients about the proper inhalers techniques.
- Encouraging patients purchasing OTC asthma inhalers or tablets to seek medical care.
- Help patients to use peak flow meters appropriately.
- Help patients discharged from the hospital to understand their asthma management plan.
- Monitor medications use and help to identify patients with poorly controlled asthma to be referred to their physician (Gibbs and Protlock, ٢٠٠١).

٤,١,٢ The value of pharmaceutical care to the asthmatic patient

Disease specific primary care clinics for chronic diseases, such as asthma provide pharmaceutical care through improved multidisciplinary collaboration. There is evidence that hospital and community pharmacists have the opportunity to co-operate with each other in a multidisciplinary team, and by doing so, they contribute in improving asthma care and preventing hospitalizations (Boyter., *et al* ٢٠٠٠). Cordina *et al* (٢٠٠١) carried out a community-based pharmaceutical care program for patients with asthma in Malta, which had positive impact on vitality of the patients, inhaler technique and peak expiratory flow rate. Stergachis *et al* (٢٠٠٢) reported the non-significant effect of pharmaceutical care

intervention in improving outcomes of pediatric patients with asthma in the community setting in Western Washington State.

Herborg *et al* (٢٠٠١) carried out two research projects on improving drug therapy for patients with asthma at the level of community pharmacy in Denmark. The first research revealed that therapeutic outcomes monitoring by community pharmacist could be effective in improving drug therapy for asthmatic patients in primary health care. The second research results showed that if community pharmacists, physicians, and patients work together, this will improve prescribing, solve drug related problems and improve outcomes for patients with moderate to severe asthma.

In١٩٩٨, Bell *et al*. reported that the pharmacist-led intervention sessions were shown to improve the primary school teachers' knowledge of asthma, and hence this may be a service, which pharmacists could provide within the community setting. Shaw *et al* (١٩٩٨) showed that quality of life of asthmatic patients could be employed as an outcome measure through pharmaceutical care provision. Pharmaceutical care of patients with asthma provided by community pharmacies in Hamburg city resulted in a clear positive impact on management of asthma and quality of life of the patients (Pharm J, ٢٠٠١).

Pharmacists solved problems in asthma management was reported by Narhi *et al* (٢٠٠٢), after the interventions, half of the patients reported that their problems have been solved, ٨٩,٢٪ of the patients reported that they were satisfied with the education and counseling provided by the pharmacists. Kheir *et al* (٢٠٠١) investigated the impact of a specialist asthma service provided by community pharmacist to a sample of asthmatic patients, their results revealed a significant improvement in asthma-related quality of life after introduction of the service and that the pharmacists were able to identify, prevent and/or solve over ٤٠٠ drug-related problems.

٤,٢ Methods and Materials

٤,٢ ١ Study Area:

The study was conducted in Shaab teaching hospital. More details about the hospital were given in chapter ٢. A meeting with the consultant physicians and other clinicians was held to discuss the research work. A verbal consent to take part in the study was provided by the patients.

٤,٢,٢ Inclusion and Exclusion Criteria

The inclusion criteria for a patient to enter the study were evidence of chronic asthma based on confirmation of its diagnosis by medical doctors, aged between ٢٠-٦٠ years, residence in Khartoum state. The exclusion criteria were patients with pregnancy, tuberculosis, mental disturbances, and listening or speaking problems.

٤,٢,٣ Study Design and Sampling Strategy

This study was carried out as prospective, randomized, controlled, and single-center trial from April ٢٠٠٣ to March ٢٠٠٤ to implement and evaluate a pharmaceutical care service for asthmatic patients. A sample of ١٠٠ patients was collected randomly from the patients attending the emergency department or the refer clinic. Simple random sampling was used for patients' allocation either in the test or control group. ٦٠ patients were in the therapeutic outcome monitoring group (TOM) and ٤٠ patients were in the control group.

٤,٢,٤ Data Collection

Data were collected via structured, developed and pre-tested questionnaire containing closed- and open-ended questions. It included all the variables relevant to the objectives of the study (Annex ١). Some of data were collected via face to face personal interviewing of the patient, others were collected after clinical examination of the patients, which were done by the medical doctor and also laboratory investigations were achieved. All the variables of the study questionnaire were filled in for each patient in both groups after being agreed to participate in the study. The outcome measures were determined during the follow-up every two weeks for ٢٢ weeks. Interventions were implemented for drug therapy

related problems that were identified in the TOM group, while the control group didn't receive any intervention.

٤,٢,٥ Outcome Measures and their Evaluation

a] Final Outcome Measures

Frequency of acute attacks per week, frequency of nocturnal symptoms per week, frequency of using β_2 – agonist per week, days of sickness per week and rate of hospitalization pre- and post-study period. Each patient was given a card to record the occurrence of each of the above mentioned measures during the previous two weeks to every follow-up.

b] Intermediate Outcome Measures

١. Peak expiratory flow rate: It was measured by peak flow meter; the best of three measures was recorded during each follow-up of the patient. The predicted value of each patient was determined according to gender, age and height (Gibbs and Small, ٢٠٠٣).

٢. Inhaler technique: The patient was observed while using the inhaler for the ١٠ steps and each correct step for the appropriate use of the inhaler was given a score of ١ and the overall score out of ١٠ for each patient was obtained by adding the scores of each correct step demonstrated by the patient.

٣. Disease knowledge: It was assessed through asking each patient about three points (what is asthma?; what are the precipitating and aggravating factors?; and how he/she can assess the severity?) and the patient score was ١ for each correct answer and ٠ for the wrong one.

٤. Drug knowledge: Each patient was asked about his/her drugs and to show, which drugs are for prevention or rescue therapy. A score of ١ indicated that the patient has good knowledge about the role of each drug in asthma management, while a score of ٠ means poor knowledge.

٥. Patient compliance to drug therapy: It was assessed through three points (dose, frequency of doses, and duration of the treatment) and each patient scores ١ for each appropriate use of the above mentioned points and ٠ for each inappropriate one.

٦. Patient compliance to non-drug therapy measures: It was assessed through three points (smoking cessation, environmental control and control of common cold and infections) and each patient scores ١ for the compliance with each measure.

٧. Ratio of prescribing inhaled steroids to bronchodilators

C) Assessment of Side-effects

Incidence of side effects: Biochemical side effects were assessed via laboratory investigations, objective side effects through clinical examination and subjective side effects as reported by the patients. Side effects were recorded when the patients enrolled in the study and during the follow-up every two weeks for ٢٢ weeks.

٤,٢,٦ Laboratory Procedures

a) Samples Collection

The patient's hand or arm was cleaned with cotton wool and ٧٠٪ethanol to remove dirt and then blood sample of ٤-٥ml was taken using sterile disposable syringe and collected in two different containers, lithium heparin container for potassium test and potassium fluoride container for glucose test. Serum was separated by centrifugation for ٢ minutes and collected in plain containers using micropipette and disposable tips.

b) Biochemical Procedure

Biochemical tests include serum potassium and random blood glucose; these tests were done for each patient in the first day and then repeated every follow up.

Test	Method	Normal values according to the method used
Serum potassium	Flame photometer	٣,٥-٥,٣ mg/dl
Random blood glucose	Glucose oxidase method	٨٠-١٢٠ mg/dl

٤,٢,٧ Data Analysis

Data was analyzed by SPSS software program version ١١.Paired sample test was used for analysis of normally distributed data and Wilcoxon test for data, which were not normally distributed .The level of significance P <٠,٠٥.

٤,٢,٨ Pilot Study:

A pilot study of data collection, entry and analysis was conducted on ١٠ patients prior to the study to ensure validity and reliability of the data collection and the results of the study. Questionnaires used in the pilot study were excluded from the study sample.

٤,٢,٩ Materials

The following equipment were used in the present work:

Equipment	Source
Sphygmanometer	KENZMEDICO CO. - Japan
Stethoscope	Littman -Germany
Peak flow meter	AIRMED- England
Weighing scale	NIKAI – Japan
Disposable syringes	Shifa medical syringes- Saudia Arabia
Measuring tape	

Drugs

The following drugs were given for patients in both groups.

Drug	Source
Salbutamol inhaler ١٠٠mcg/puff (Ventolin®)	Glaxo- Wellcome England
Salmeterol inhaler ٥٠ mcg/puff (Serevent®)	Glaxo- Wellcome England
Beclomethasone inhaler ٥٠ mcg/ puff (Becotide®)	Glaxo- Wellcome England
Fluticasone dipropionate inhaler ٥٠ and ١٢٥ mcg/puff (Flixotide®)	Glaxo- Wellcome England
Budesonide ٢٠٠ and ٤٠٠mcg/puff (Pulmicort®)	Astra-Zeneca-Sweden
Salbutamol tablets ٢mg (Butalin®)	Gulf pharmaceutical industries, Ras Al Khaima, U.A.E.

٤,٣ Results and Discussion

٤,٣,١ Demographic Data of the Study Population

Table ٤,١ shows the distribution of patients according to their number during the study period. The study included ٦٠ patients in the TOM group and ٤٠ patients in the control group. During the study period ١٢ patients of the TOM group and ١٠ patients of the control group were dropped out. From the TOM group one patient was died at his home after ٦ weeks from his contribution in the study due to acute severe asthmatic attack and two patients changed their residence and found it difficult to come every two weeks to Shaab hospital, others felt that they are fine and there is no need to attend the follow-up. From the control group two patients get pregnant, but the rest of patients dropped out without obvious reasons.

Table ٤,١ Distribution of patients according to their number during the study period

Number of Patients	Control	TOM
Baseline Enrollment	٤٠	٦٠
Follow-Up Weeks		
٢ weeks	٣٤	٥٨
٤weeks	٣٣	٥٦
٦ weeks	٣٢	٥٥
٨ weeks	٣٠	٥٢
١٠ weeks	٣٠	٥٢
١٢ weeks	٣٠	٥١
١٤ weeks	٣٠	٤٨
١٦ weeks	٣٠	٤٨
١٨ weeks	٣٠	٤٨
٢٠weeks	٣٠	٤٨
٢٢ weeks	٣٠	٤٨

In the control group, the study population enrolled was ٣٥٪ (١٤) males and ٦٥٪ (٢٦) females, while those in the TOM group were ٤٨,٧ % (٢٩) males and ٥١,٣٪ (٣١) females. The percentage of females in both groups was non-significantly higher than that of males. In Sudan, Abuobieda (٢٠٠١) reported a non-significant higher prevalence of asthma in males than in females.

Table ٤,٢ and figure ٤,١ show the distribution of patients according to their age groups .In TOM group the majority of patients were aged between ٣١-٤٠ years while in control group the largest proportion were

in the age group of ٢٠-٣٠ years. In Sudan, there was no available statistical data about the prevalence of asthma according to age, in this study the prevalence of asthma is high in the age group ٢٠-٤٠ years. Data from other countries showed that in Swiss population asthma was more prevalent in the age group of ٢٥-٣٠ years, and in Australia it was reported that one child in six under the age of ١٦ is affected by asthma (WHO ٢٠٠٠). Glen (٢٠٠٠) reported that in USA the highest rate of asthma death is by the age of ٢٥-٣٤ years.

Table ٤,٢ Distribution of patients according to age groups

Age of Patients (years)	Number of Patients	
	Control	TOM
٢٠-٣٠	١٦	١٨
٣١-٤٠	١٠	٢٦
٤١-٥٠	١١	١٣
٥١-٦٠	٣	٣

Figure ٤,١ Distribution of patients according to age groups

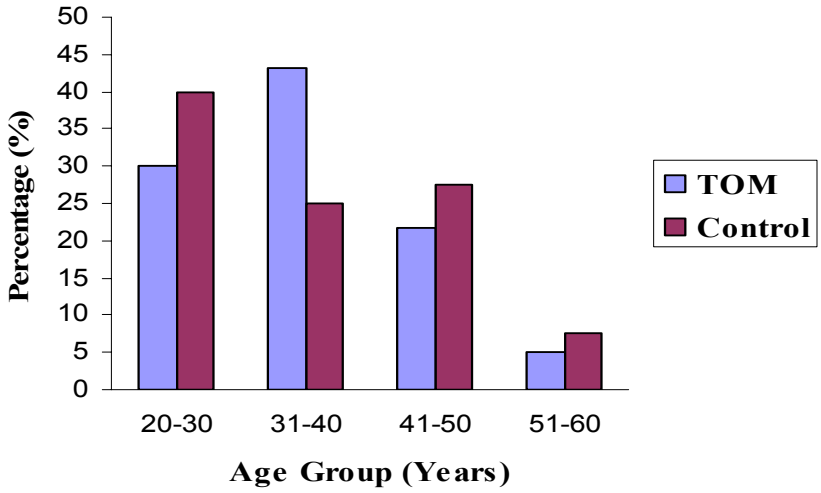


Table ٤,٣ and figure ٤,٢ show the distribution of patients according to their duration of being asthmatics. Most of the TOM patients were asthmatics for ١٠-٢٠ years, while most of control patients had the disease for less than ١٠ years

Table ٤,٣ Distribution of patients according to the duration of the disease

Duration of disease (years)	Number of Patients	
	Control	TOM
<١٠	٢٠	١٤
١٠-٢٠	١٣	٣١
٢١-٣٠	٦	١٠
٣١-٤٠	٠	٢
٤١-٥٠	١	٣

Figure ٤,٢ Distribution of patients according to the duration of the disease

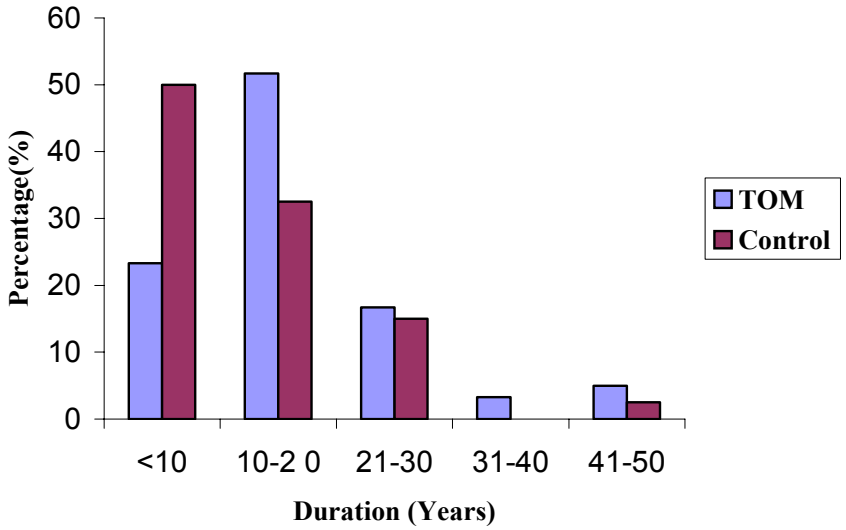
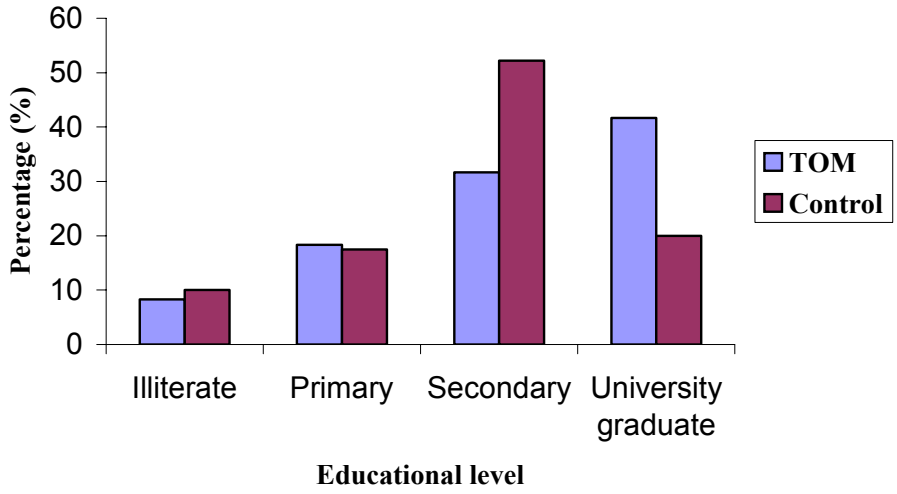


Table ٤,٤ and figure ٤,٣ show the distribution of patients according to their level of education. The majority of the patients in the TOM group were university graduates, while those in control group were of secondary education.

Table ٤,٤ Distribution of patients according to level of education

Education level	Number of Patients	
	Control	TOM
Illiterate	٤	٥
Primary	٧	١١
Secondary	٢١	١٩
University graduate	٨	٢٥

Figure ٤,٣ Distribution of patients according to their level of education



٤,٣,٢ Risk Factors of the Patients

Table ٤,٥ and figure ٤,٤ show the distribution of patients according to smoking. In both groups the proportion of smokers was very small. WHO (٢٠٠٠) reported that tobacco smoking is one of the risk factors associated with the development of asthma. One patient in the control group and three from the TOM are smokers. The majority of patients in both groups are non-smokers.

Table ٤,٥ Distribution of patients according to smoking

Smoking	Number of Patients	
	Control	TOM
Smoker	١	٣
Non-smoker	٢٩	٤٣
Stopped smoking	١٠	١٤

Figure ٤,٤ Distribution of patients according to smoking

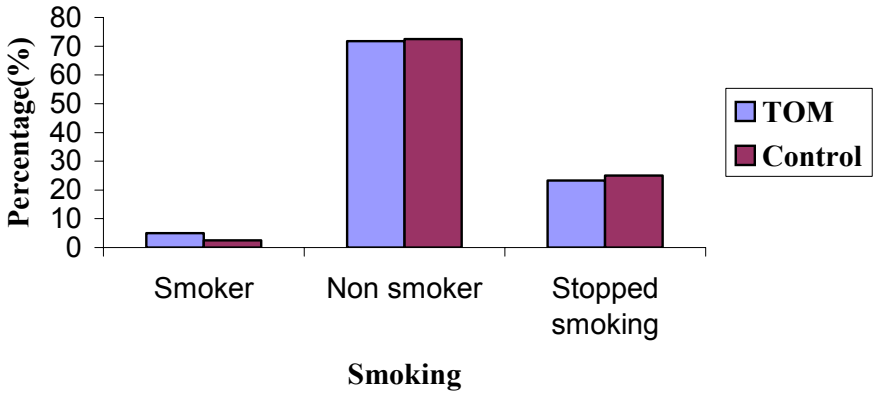
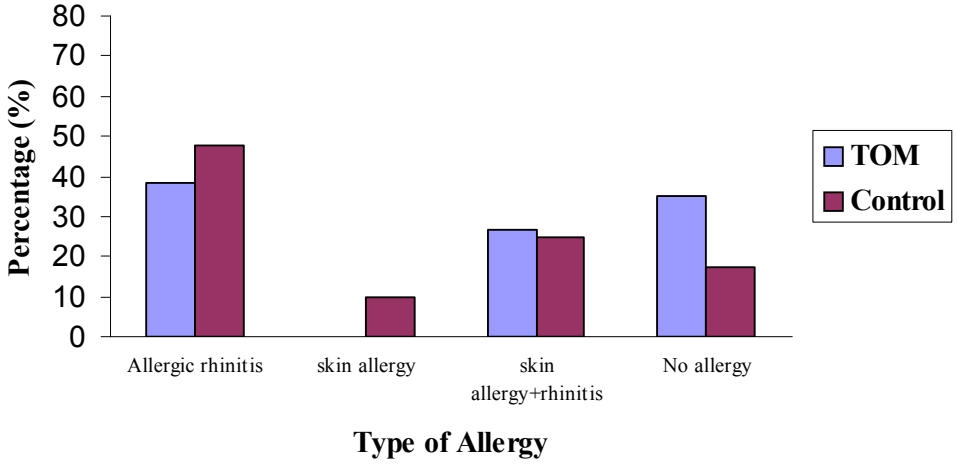


Table ٤,٦ and figure ٤,٥ show that allergic rhinitis was more prevalent in both groups. Allergic rhinitis is an important risk factor for asthma and its treatment from the very beginning of its inception is the effective way to prevent bronchial asthma (WHO, ٢٠٠٠). Studies confirmed that immunotherapy is capable of preventing the onset of asthma in children with allergic-rhinitis. It was also proved that rhinitis and asthma were strictly linked, and up to ٥٠٪ of patients with rhinitis have asthma and rhinitis occur in up to ٨٠٪ of patients with asthma. It was demonstrated that the bronchial mucosal inflammation does not differ between asthmatics and rhinitics at least from the morphological point of view and this was confirmed by the fact that there was no difference in eosinophil count, interlukin-٥, and interlukin – ١٠ generation in bronchoalveolar lavage fluid from asthmatics and rhinitics. In patients with asthma and rhinitis, it was found that correct treatment of allergic rhinitis with nasal steroids significantly reduced the rate of hospital admittance and emergency department visits due to asthma exacerbations (Giovanni *et al,* ٢٠٠٤).

Table ٤,٦ Distribution of patients according to history of allergy

Type of allergy	Number of Patients	
	Control	TOM
Allergic rhinitis	١٩	٢٣
Skin allergy	٤	٠
Rhinitis+skin allergy	١٠	١٦
No allergy	٧	٢١

Figure ٤,٥ Distribution of patients according to history of allergy



Tables ٤,٧, ٤,٨ and figures ٤,٦, ٤,٧ show the distribution of patients according to family history of asthma and atopy, respectively. It was noticed that high percentage of patients in both groups had positive family history of asthma and atopy. In ٢٠٠١, WHO considered family history of asthma or allergy as risk factors for developing asthma and a study in the South Atlantic Island of Tristanda Cunha found that children with asthmatic parents were much more likely to develop asthma. In Sudan, Ahmed (١٩٩٦) reported that family history of atopy was often present in children with asthma and helpful in diagnosis of patients.

Table ٤,٧ Distribution of Patients According to family history of asthma

Family History	Number of Patients	
	Control	TOM
Positive	٢٩	٤١
Negative	١١	١٩

Figure ٤,٦ Distribution of patients according to family history of asthma

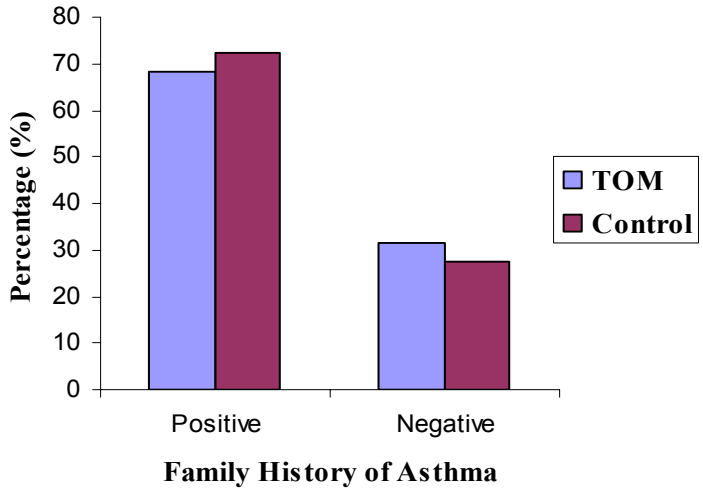


Table ٤,٨ Distribution of patients according to family history of atopy

History	Number of Patients	
	Control	TOM
Positive	٣٤	٤٥
Negative	٦	١٥

Figure ٤,٧ Distribution of Patients According to family history of atopy

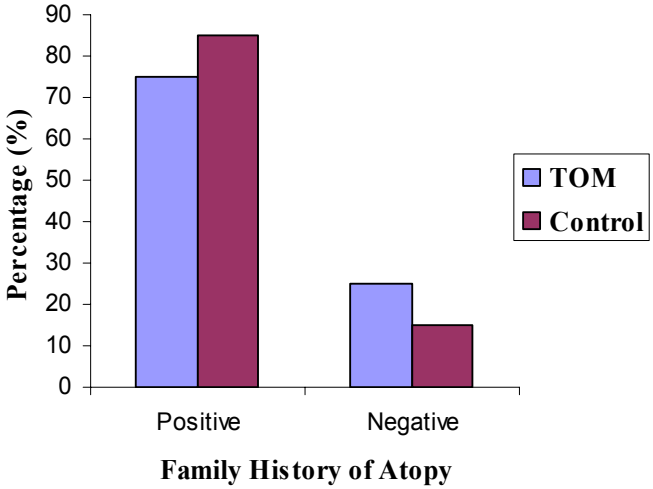
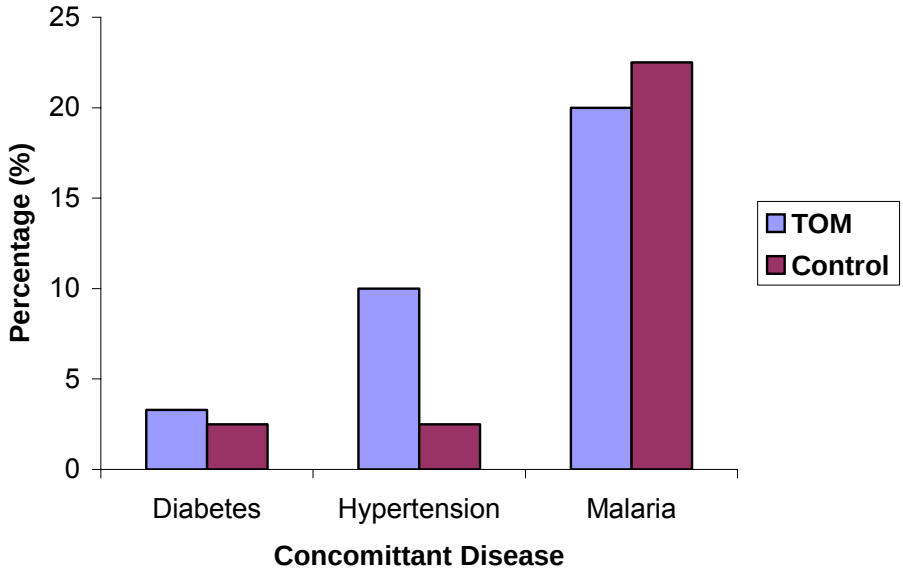


Table ٤,٩ and figure ٤,٨ show the distribution of patients according to the presence of concomitant diseases. Malaria was the common concomitant disease for both groups when patients enrolled into the study. Awad (٢٠٠١) reported that malaria accounts for about ٢١٪ of all diseases in out-patient clinics and about ٣٢٪ of in-patient admissions; this indicates that malaria is one of the problematic diseases in Sudan. A lot of patients complaining that their asthma symptoms are aggravated with malaria but there are no evidence in the literature review indicating the association between malaria and asthma, it is recommended that this relation should be investigated.

Table ٤,٩ Distribution of patients according to presence of concomitant diseases

Disease	Number of Patients	
	Control	TOM
Diabetes	١	٢
Hypertension	١	٦
Malaria	٩	١٢

Figure ٤,٨ Distribution of patients according to presence of concomitant diseases



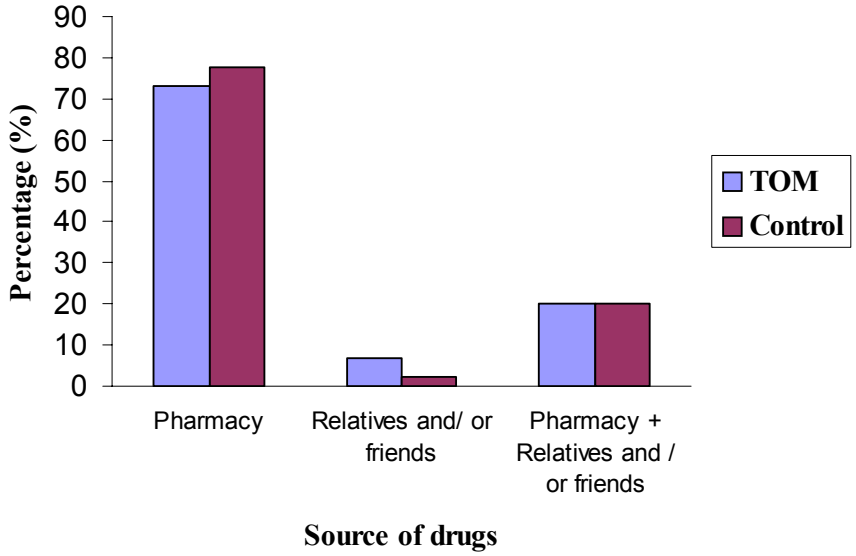
٤,٣,٣ Management of Asthma

Table ٤,١٠ and figure ٤,٩ show the distribution of patients according to the sources from which they obtained their drugs. Pharmacy was the main source of drugs in both groups, other sources are relatives and / or friends, and this indicated the share of drugs within the community, which may lead to the irrational use of drugs.

Table ٤,١٠ Distribution of patients according to the source of obtaining their drugs

Source	Number of Patients	
	Control	TOM
Pharmacy	٣١	٤٤
Pharmacy + Relatives and / or friends	٨	١٢
Relatives and / or friends	١	٤

Figure ٤,٩ Distribution of patients according to the source of obtaining their drugs



Despite the fact that drugs for asthma management were mainly obtained from the pharmacy, the patient counselling was not provided mainly by the pharmacists. Table ٤,١١ and figure ٤,١٠ show that the physician was the main provider of counselling to the majority of patients. It was

not known whether this was due to that patients trust physicians more than pharmacists or the pharmacists do not provide the counselling to the patients. Physicians are always over loaded with patients and they may have not the required time for appropriate counselling. Pharmacists as member of the health care team can help effectively in providing the appropriate patient counselling. A lot of researches worldwide confirmed that pharmacy practice had shed the role of dispensing to patient oriented practice. Narhi *et al* (٢٠٠٢) reported that ٨٩,٢٪ of the patients in their study were satisfied with the education and counselling provided by pharmacists, which is a significant higher percentage than for physicians and nurses.Patient education and counseling are of great importance in asthma management since they lead to increased patient confidence in ability to self –manage asthma, decrease hospital admission rates and emergency visits and improving compliance and quality of life (Gibbs and Protlock, ٢٠٠١).

In ١٩٨٧, FDA reported ١٢،٠٠٠ deaths and ١٥،٠٠٠ hospitalizations due to adverse drug reactions, these adverse reactions can be reduced by providing pharmaceutical services, which can also reduce the length of hospital stays and the cost of care (Helper and Strand ١٩٩٠). Nadir *et al* (٢٠٠١) reported that during their study pharmacists were able to identify, prevent or resolve over ٤٠٠ drug-related problems. So pharmacists should accept their social mandate to ensure safety and effectiveness of drug therapy for the individual patient and set new practice standards and cooperate with other health care professionals for the patients benefit. Implementation of pharmaceutical care service in private and public pharmacies is of greater importance, they could fill the role as communicators, collaborators and front- line health care members providing appropriate patient counselling and referring serious cases to medical doctors.

Table ٤،١١ Distribution of patients according to the provider of patient counseling

Provider	**Number of Patients**	
	Control	**TOM**
Pharmacists	٣	٦
Physicians	١٠	٢١
Pharmacists + physicians	٩	٧
Self	٢	٦

Figure ٤,١٠ Distribution of patients according to the provider of patient counselling

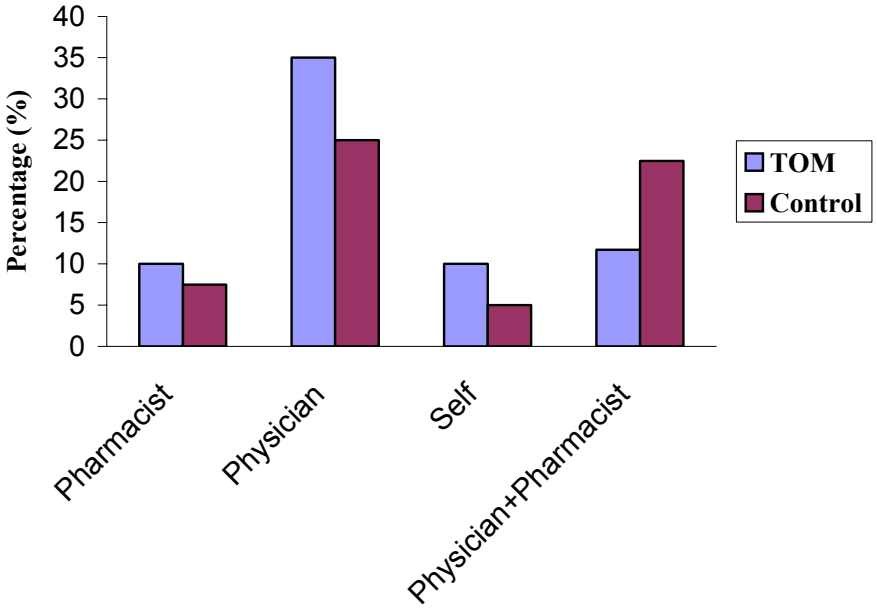
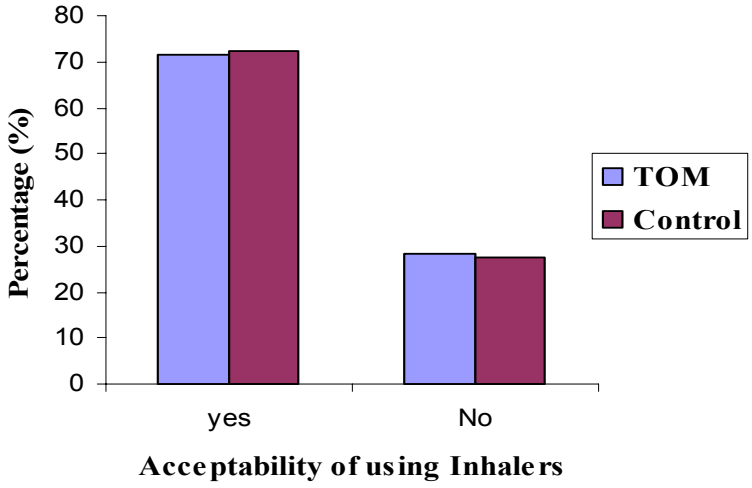


Table ٤,١٢ and figure ٤,١١ show the distribution of patients according to their acceptability of using inhalers. In both groups, the percentage of patients who do not accept the inhaler use was less than those who accepted its use. There are still wrong beliefs about the use of an inhaler in the Sudanese community such as its use indicates the deterioration of the disease condition to some patients, while others believe that it has cardiac side effects. Other group of patients does not prefer the use of the inhalers for economic reasons, as they are more expensive than oral drugs and for the same reason some physicians do not prescribe them for the patients. The topical application of drugs to the lungs can be accomplished by using inhalers and this approach produce a high local concentration in the lungs with low systemic delivery, thereby significantly improving therapeutic ratio by minimizing systemic side effects (Joel *et al.*, ٢٠٠١)

Table ٤,١٢ Distribution of patients according to their acceptability of using inhalers

Acceptability	Number of Patients	
	Control	TOM
Yes	٢٩	٤٣
No	١١	١٧

Figure٤,١١ Distribution of patients according to their acceptability of using inhalers



Concerning the patients' compliance with the nebulizer use, a high percentage of patients in both groups have a good compliance as shown in table ٤,١٣ and figure ٤,١٢. Only ٧ patients (٤ TOM and ٣ control) have nebulizers at home. The reasons for non-compliance include that the masks were used by a large number of patients in the hospital and this would subject them to a high risk of acquiring infections. Others have bad experience of tremors and palpitations with nebulizers. The later reason was confirmed in this study that the doses of $\beta_{٢}$-agonist administered to patients via nebulizers were high and this increased the risk of their adverse reactions.

Table ٤,١٣ Distribution of patients according to their acceptability of using nebulizer

Acceptability	**Number of Patients**	
	Control	**TOM**
Yes	٣٥	٥٢
No	٥	٨

Figure ٤,١٢ Distribution of Patients According to their acceptability of using nebulizer

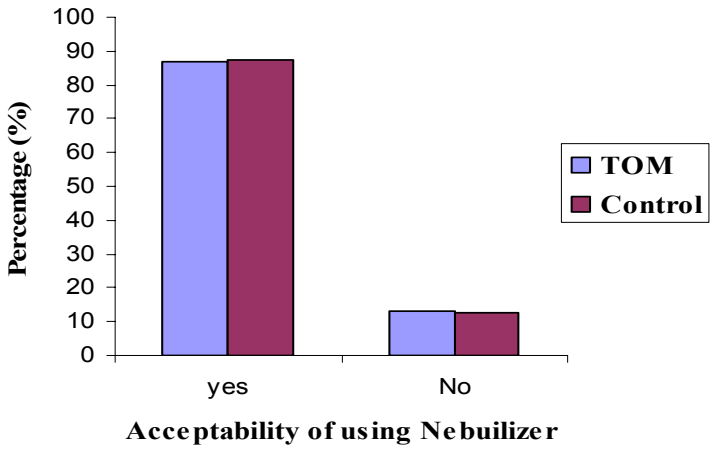
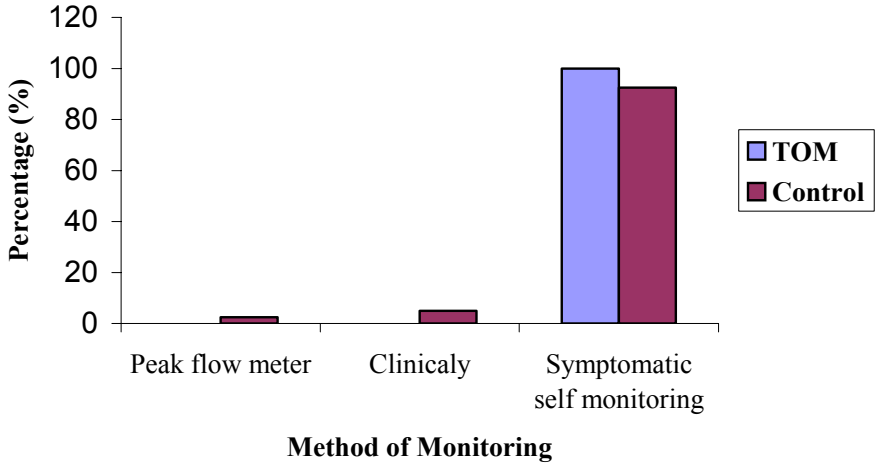


Table ٤,١٤ and figure ٤,١٣ show the distribution of patients according to their method of monitoring asthma. Symptomatic self-monitoring was the common ways of monitoring asthma in both groups. Thus the majority of patients did not use the appropriate means of monitoring their disease. A lot of patients did not know the peak flow meter because it not available even in the hospitals despite the fact that it is very cheap and of great value in monitoring asthmatic patients.

Table ٤,١٤ Distribution of patients according to their method of monitoring asthma

Method	Number of Patients	
	Control	TOM
Peak flow meter	١	٠
Clinically	٢	٠
Symptomatic self monitoring	٣٧	٦٠

Figure ٤,١٣ Distribution of patients according to their method of monitoring asthma



٤,٣,٤ Problems and Interventions

Table ٤,١٥ show the problems identified in the TOM group and the interventions implemented.

Table ٤,١٥ Drug therapy related problems and other problems identified in the intervention group

Problem	Percentage [Number]	Suggested Intervention	% Accepted and implemented
١. Management of chronic asthma did not follow the British Thoracic Society guidelines	٦٨,٣ % (٤١)	The prescribers were informed about the appropriate individual management for each patient.	١٠٠٪
٢. Inappropriate dose of oral prednisolone	١٣,٣٪(٨)	The prescribers were informed about the appropriate dose	١٠٠%
٣. Chronic use of prednisolone instead of inhaled steroids	٤٣,٣٪(٢٦)	The prescribers and patients were informed about the advantages of inhaled steroids and the differences in side effects between oral and inhaled steroids	٨١٪
٤. Refusal of using inhalers by the patients	٢٨,٣٪(١٧)	The patients were informed about the difference in side effects between oral and inhalation therapy and advantages of inhalational therapy	٩٤,١٪
٥. Absence of inhaled corticosteroids in the patient regimen	٥٣,٣٪ (٣٢)	The prescribers were informed about the importance of inhaled corticosteroids as preventive therapy.	١٠٠٪
٦. Chronic use of oral β_2-agonist instead of inhaled therapy	٣١,٧٪(١٩)	The prescribers and patients were informed about the advantages of inhaled β_2-agonist and the difference in side effects between oral and inhaled therapy	٩٣,٣٪

٧. Prescribing of Terbutaline with Salbutamol	١,٧٪(١)	The prescriber was informed about the risk of adverse effects associated with the use of two β_2-agonists	١٠٠٪
٨. Inappropriate prescribing of Norfloxacin for chest infection	١,٧٪(١)	The prescriber was informed that it was not the appropriate drug.	١٠٠٪
٩. Use of peak flow meters for monitoring	١٠٠٪ (٦٠)	Its value and importance was explained to the patients	٥٪, it was accepted but due to its non-availability in Sudan people were not able to get it
١٠. Inadequate knowledge about the role of each drug in treatment of therapy	٤٨,٣٪(٢٩)	Patients were informed about the role of each drug in their treatment of asthma	١٠٠٪
١١. Inappropriate technique of the use of inhalers	٨١,٧٪ (٤٩)	Patients informed about the correct inhaler technique according to standard inhaler technique chart	١٠٠٪
١٢. Side-effects **a] Oral thrush**	١٦,٧٪(١٠)	Patients prescribed Mycostatin oral suspension and counselled about rinsing their mouth after using steroid inhalers and changing their tooth brushes continuously.	١٠٠٪
b] Hyperglyacemia (prednisolone)	١,٧٪(١)	The Patient was advised to stop prednisolone and was referred to an endocrinologist	٠٪ [The Patient refused to see the doctor and continue in taking prednisolone]
c] Tremors, palpitations as side effects	٥٦,٧٪(٣٤)	The oral use of β_2-agonist was recommended to be stopped and replaced by inhaled β_2-agonist as required.	٨٨,٨٪

١٣. Drug-interactions	١٦,٧٪(١٠)	Prescribers were informed about the risk of adverse effects associated with concomitant administration of Erythromycin and Theophylline	٣٧,٥٪
١٤. Patients non-compliance to the treatment	٦٥ % (٣٩)	The patients were educated about the appropriate dose, frequency and the importance of the continued drug therapy	١٠٠٪
١٥. Self-administration of direct I.V Aminophylline	٣,٣٪(٢)	Patients informed about the serious adverse effects that could result from this inappropriate use.	٥٠٪
١٦.Undetected hypertension	٣,٣٪(٢)	Patients' BP was followed up and antihypertensive drugs were prescribed	١٠٠٪ [controlled]
١٧. Smoking	٥٪(٣)	The patients were informed about smoking and its serious complications	٠٪ still they are smoking but not frequently
١٨. Allergic rhinitis	٦٥٪(٣٩)	The patients were referred to ENT hospital	٢٥,٦٪

٤,٣,٤ Outcome Measures for the Evaluation of the Impact of Implementing the Pharmaceutical Care Service

The mean (standard deviation) differences of the patients outcome effect variables are presented in tables ٤,١٦ –٤,٢٦ for the TOM and control groups together from ٠ to ٢٢ weeks and P values for the paired sample t-test and Wilcoxon test.

a) Final Outcome Measures

Table ٤,١٦ shows that the change in the frequency of acute attacks per week, at the baseline enrollment, there was no significant difference (P>٠,٠٥) between both groups in the number of acute attacks per week. The frequency was decreased significantly within both groups during the follow-up weeks, a highly significant decrease was achieved the TOM group when compared to the control group. The difference in reduction was significantly more in the TOM group except at the ١٢ weeks of follow-up the difference was non-significant (P>٠,٠٥).

Table ٤,١٦ Frequency of acute attacks per week

Group	Frequency of acute attacks per week [Mean (SD)]											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	٢,١٠ (٠,١٧)	-١,٤٣ (٠,١٦)	-١,٨٣ (٠,١٦)	-١,٨٥ (٠,١٦)	-١,٩١ (٠,١٧)	-١,٨١ (٠,١٦)	-١,٨٣ (٠,١٧)	-١,٩١ (٠,١٦)	-٢,٠٤ (٠,١٧)	-١,٨٩ (٠,١٧)	-١,٩٣ (٠,١٧)	-١,٩١ (٠,١٨)
Control	١,٤٠ (٠,١٣)	-٠,٦٣ (٠,١٠)	-٠,٩٦ (٠,١)	-٠,٧٠ (٠,١١)	-٠,٩ (٠,١٢)	-٠,٩٦ (٠,١٣)	-١,١٠ (٠,١٣)	-٠,٨٦ (٠,١٤)	-٠,٩٣ (٠,١١)	-٠,٩ (٠,١٣)	-٠,٩٣ (٠,١٢)	-١,٠ (٠,١٤)
P-value	٠,٠٨	٠,٠٣	٠,٠٣	٠,٠٠	٠,٠٢	٠,٠٢	٠,٠٦	٠,٠٢	٠,٠١	٠,٠٢	٠,٠١	٠,٠٣

- **- [Decreased]**
- **wks [Weeks]**

Table ٤,١٧ shows the change in the frequency of the nocturnal asthma symptoms during the study period in the TOM and control groups. At the baseline enrollment, there was no significant difference (P>٠,٠٥) between both groups in the frequency of the nocturnal asthma symptoms. Both groups have shown a significant decrease in the frequency of nocturnal symptoms. On comparing the reduction in the frequency between the groups, it was found that the TOM group had a greater significant reduction than the control group during the ٢٠th and ٢٢nd weeks of the follow-up.

Table ٤,١٧ Frequency of nocturnal asthma symptoms per week

Group	Frequency of nocturnal symptoms per week [Mean (SD)]											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	٤,٣٥ (٠,٣)	-٠,٨٨ (٠,٠٤)	-٢,٣٨ (٠,٢)	-٣,١٢ (٠,٣)	-٣,٤٥ (٠,٣١)	-٣,٥٨ (٠,٣٤)	-٣,٢٢ (٠,٣٤)	-٣,٧٥ (٠,٣٢)	-٣,٠٢ (٠,٣٣)	-٣,٣٧ (٠,٣٣)	-٣,٥٢ (٠,٣٥)	-٣,٤٥ (٠,٣٣)
Control	٣,١٠ (٠,٢٩)	-٠,٢٦ (٠,٠٣)	-٠,٨٨ (٠,٠٥)	-١,٥١ (٠,٣٩)	-١,٣٦ (٠,١٨)	-١,٥٦ (٠,١٦)	-١,٥٨ (٠,٢٦)	-١,٧٦ (٠,١٨)	-١,٦١ (٠,١٧)	-١,٣٥ (٠,١٣)	-١,٦٣ (٠,١٦)	-١,٠٨ (٠,١٦)
P-value	٠,١٤	٠,٦٨	٠,٣٥	٠,٢٥	٠,٠٦	٠,١١	٠,٠٨	٠,٠٦	٠,٢٢	٠,٠٦	٠,٠٤	٠,٠٢

- **- [Decreased]**
- **wks [Weeks]**

Table ٤,١٨ shows the change in the frequency of using inhaled β_2-agonist per week, at the baseline enrollment, there was no significant difference (P>٠,٠٥) between both groups There was a statistically significant decrease (P< ٠,٠٥) in the use of β_2-agonist per week within the groups during the follow-up weeks. A highly significant reduction (P<٠,٠٥) was achieved in the TOM group from the ٦th week to the ٢٢nd week when compared to the control group.

Table ٤,١٨ Frequency of using Inhaled β_2-agonist per week

Group	Frequency of using - β_2 agonist per week [Mean (SD)]											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	٢٦,٨ (٢,٤)	-٩,٠ (٠,٨)	-١١,٥ (١,٤)	-١٦,٠ (١,٨)	-١٦,٣ (١,٧)	-١٨,٩ (١,٩)	-١٩,٠ (٢,٠)	-١٩,٥ (١,٩)	-١٨,٩ (٢,٠)	-١٦,٨ (١,٨)	-١٩,٨ (٢,٠)	-١٩,٩ (٢,١)
Control	١٩,١ (٢,١)	-٣,٣ (٣,٢)	-٨,٣ (٠,٨)	-٠,٩٠ (٠,٠٩)	-٣,١ (٢,٦)	-٣,٨ (٣,٧)	-٥,٢٦ (٠,٦)	-٤,٥٣ (٠,٤)	-٨,٩٣ (٠,٩)	-٧,٢ (٠,٧)	-٦,٥٦ (٠,٨)	-٣,٣ (٠,٣)
P-value	٠,١٧٢	٠,٣٥٣	٠,٤٥٩	٠,٠٠٢	٠,٠٣٦	٠,٠١٣	٠,٠٢٢	٠,٠٢٥	٠,٠٤٥	٠,٠٩٨	٠,٠٣١	٠,٠١٨

- **- [Decreased]**
- **wks [Weeks]**

Table ٤,١٩ shows the change in the in days of sickness per week, at the baseline enrollment, there was no significant difference (P>٠,٠٥) between both groups. A significant reduction (P<٠,٠٥) in the days of sickness was shown in the TOM group, while in the control group the days of sickness were increased . Table ٤,٢٠ shows the rate of hospitalization per ٦ months in both groups before being enrolled in the study and at the end of the study period. It was decreased significantly (P<٠,٠٥) in the TOM group, while increased non-significantly (P>٠,٠٥) in the control group.

Table ٤,١٩ Days of sickness per week

Group	Days of sickness per week **[Mean (SD)]**											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	١,٤٧ (٠,١٦)	-٠,٤٣ (٠,٢٣)	-١,١٢ (٠,١٧)	-٠,٨٩ (٠,٠٧)	-٠,٨٧ (٠,٠٨)	-١,٢٠ (٠,١٥)	-١,٣٩ (٠,١٦)	-١,٣٩ (٠,١٧)	-١,٣٣ (٠,١٦)	-١,١٨ (٠,١٨)	-١,٢٢ (٠,١٣)	-١,٣٩ (٠,١٤)
Control	٠,٩٣ (٠,١٥)	+٠,٦٦ (٠,٠٥)	+ ٠,٣٣ (٠,٠٤)	+٠,٤٠ (٠,٠٣)	+ ٠,١٦ (٠,٠٢)	+ ٠,٢٣ (٠,٠٢)	+ ٠,٠٦ (٠,٠١)	+ ٠,١٣ (٠,٠٢)	+ ٠,١٠ (٠,٠١)	+ ٠,٤٣ (٠,٠٢)	+ ٠,٨٦ (٠,٠٦)	+ ٠,٩٦ (٠,٠٩)
P-value	٠,٦٣	٠,٢٤	٠,٠٤٥	٠,٠٧٦	٠,٤٢١	٠,٠٥٢	٠,٠١٥	٠,٠١٧	٠,٠٥	٠,٠٣٣	٠,٠٠٦	٠,٠٠٢

- **- [Decreased]**
- **+ [Increased]**
- **wks [Weeks]**

Table ٤,٢٠ Rate of hospitalization per ٦ months before enrollment in the study and at the end of the study period

Hospitalization rate [Mean (SD)]		
Group	Before the study	After the study
TOM	٠,٧٢٩(٠,٠٨)	٠,٢٧٠(٠,٠٢)
P-value	٠,٠٠٩	
Control	٠,٣٠(٠,٠٢)	٠,٥٣(٠,٠٥)
P- value	٠,٢٥٧	

The results of the present study have shown that patients in the TOM group had better final outcomes than patients in the control group. TOM patients had significant better asthma symptom status, reduction in the occurrence of nocturnal asthma symptoms, the use of inhaled β_2 agonists, days of sickness and rate of hospitalization. Although the number of patients in this study were small, its findings imply that the pharmacist's intervention had an effect in terms of improving the quality of care for asthmatic patients and this was shown through the improvement of the final outcome measures in the TOM group.

A similar result was reported by Schultz *et al* (٢٠٠٠). In ٢٠٠١, Herborg *et al* had shown that pharmacists' intervention decreased the consumption of β_2 - agonists in the intervention group more significantly than in the control. The patients in the intervention group showed a diminished risk of sick days during the study year and the proportion of sick days per patient per month (PPPM) relative to control tended to decrease over the ١٢ months by about ٥٪ each month but over the last ٤ months of the study, the patients in the intervention group reported about ٢٥٪ as many sick days as patients in control group.

Cordina *et al.*(٢٠٠١) reported that significantly more patients in the intervention group than in the control group reported nighttime wheezing all the time or most of the time at the final assessment point. They also showed in their study that no member of the intervention group was hospitalized during the study period but ٨ patients in the control group were hospitalized due to asthma exacerbations and the self – reported hospitalization rates were significantly different between the two groups. She reported that the statistical analysis did not reveal any significant differences in the responses between the intervention and control groups regarding days lost from work or school. In ١٩٩٥, Boulet *et al* found that a decreased number of days lost from work in their intervention group compared with the control group.

Both groups in this study demonstrated improved outcomes during the study period, this may have tended to reduce the apparent effect size of the pharmaceutical service. A number of factors could be at work here. First, the identification of the drug-related problems in the TOM group and their discussion with the medical doctors have changed their prescribing patterns and they have implemented the majority of these interventions to the control group providing some new care practices. Second, filling out questionnaires and meeting at evaluation sessions may be an educational intervention itself. The design of this study imposed certain limitations. Two hospitals, one for the TOM and the other for the control patients were necessary to avoid any overlap between the intervention and control groups. The dropouts of the patients decreased the study sample, some of the healthiest patients dropped out stating that they did not require the service for ٦ months.

b) Intermediate Outcome Measures

Table ٤,٢١ shows the change in the peak expiratory flow rate in both groups, at the baseline enrollment, there was no significant difference (P>٠,٠٥) between both groups. The PEFR was measured every two weeks during the follow-up and not on daily basis and that was mainly due to the lack of availability of the required number to be given to the patients. There was a significant increase (P>٠,٠٥) in PEFR of patients in both groups (P < ٠,٠٥) throughout the study period. The change in the PEFR between both groups was not statistically significant (P>٠,٠٥). The TOM patients showed a higher mean percentage of improvement in the PEFR from the ١٢th week till the end of the study.

In ٢٠٠١,Cordina *et al.* and Herborg *et al* reported a non- significant difference between the intervention and control groups in the improvement of the PEFR. Balley *et al* (١٩٩٠) reported improvements in morning PEFR for the intervention groups compared with controls. Bergmann *et al* (١٩٩٢) showed improvements in FEV١ in the intervention groups. Grainger-Rousseau (١٩٩٢) and Allen *et al* (١٩٩٥) reported that intervention programs with ambulatory patients with asthma showed no changes.

Table ٤,٢١ Peak Expiratory Flow Rate

Group	PEFR **[Mean (SD)]**											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	٢٥٣,٩ (١٠,٥)	+٢٦,٠٤ (٣,٧)	+٢٨,٧٥ (٢,٧١)	+٤٣,٧٥ (٣,١١)	+٤٨,١٢ (٤,٢)	+٤٥,٦٢ (٤,٤١)	+٥١,٢٥ (٤,٦٣)	+٥٣,٣٣ (٥,٧١)	+٦٦,٢٥ (٧,١٨)	+٥٧,٩١ (٥,٥٣)	+٥١,٠٤ (٥,١٥)	+٥١,٨٧ (٥,٥٣)
Control	٢٥١,٦ (٩,٩)	+٥٢,٣٣ (٦,٢١)	+٦١,٣٣ (٦,٤٤)	+٥٣ (٥,٢)	+٤٧,٦٦ (٤,٨٩)	+٤١,٣٣ (٤,٨٥)	+٤٤,٦٦ (٤,٢٦)	+٤٢,٣٣ (٥,٨٢)	+٣٨ (٣,٦٨)	+٤٣,٦٦ (٤,٥٨)	+٣٩,٠ (٣,٨٢)	+٣٠,٦٦ (٣,١٥)
P-value	٠,١٢٤	٠,٥٠	٠,٤٣٧	٠,٧٤١	٠,٥٧٨	٠,٣٢٣	٠,٣٢٩	٠,١٧٨	٠,٠٨٤	٠,٤١٥	٠,١٩٤	٠,٠٥١

- **+ [Increased]**
- **wks [Weeks]**

Table ٤,٢٢ shows the change in the score for the technique of the inhaler use, at the baseline enrollment, there was no significant difference (P>٠,٠٥) between both groups. There was a significant improvement in the score for the inhalation technique within both groups during the follow-up period. The patients in

the TOM group showed a highly significant greater improvement (P<٠,٠٥) than those in the control. Most of asthma medications are given by inhalation and without proper technique and optimal medication delivery, drugs will not be as effective as it could be, and the fault would not be necessarily with medication but due to inadequate administration, thus, the proper technique must be taught to the patients (Peebles *et al*., ٢٠٠٢).

Campeu (٢٠٠٢) reported that ٨٠٪ of patients failed to actuate and inhale simultaneously when using MDI, while others positioned the canister close to the chest or away from the mouth. The dangerous problem is that some patients may inhale objects such as earrings or pen tops which ledged in the device if the caps are lost. She also stated that inhaler technique should be checked annually or ideally every visit to reinforce good technique. Also she pointed that poor inhaler technique reduces the disease control.

Cordina *et al.* (٢٠٠١) reported that significant difference between scores of baseline and ١٢ month evaluation was noticed in the intervention group, while Herborg *et al* (٢٠٠١), showed that the number of inhalation errors decreased for both intervention and control groups, but the intervention group showed more significant decrease in the inhalation errors than the control group.

Table ٤,٢٢ Technique of inhaler use

Group	Technique of inhaler use [Mean (SD)]											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	٤,٥٦ (٠,٣٨)	+ ١,٨٩ (٠,١٨)	+ ٣,١٤ (٠,٢٨)	+ ٣,٦٢ (٠,٣٧)	+ ٣,٨٣ (٠,٣٨)	+ ٤,٢٢ (٠,٤٨)	+ ٤,٢٥ (٠,٤٢)	+ ٤,٤٧ (٠,٥٧)	+ ٤,٧ (٠,٥٨)	+ ٤,٨٥ (٠,٤٥)	+ ٤,٨٥ (٠,٨٣)	+ ٤,٩١ (٠,٤٧)
Control	٦,٢٣ (٠,٥٢)	+ ٠,٨٦ (٠,٠٧)	+ ٠,٧٣ (٠,٠٦)	+ ٠,٧٦ (٠,٠٨)	+ ٠,٩٠ (٠,٠٩)	+ ١,٠٣ (٠,١٧)	+ ١,٠٦ (٠,١٨)	+ ١,٠٦ (٠,١٨)	+ ١,٠٦ (٠,١٨)	+ ١,٠٦ (٠,١٨)	+ ١,٠٦ (٠,١٨)	+ ١,٠٦ (٠,١٨)
P-value	٠,٠٣	٠,٠٤	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠	٠,٠٠

- **+ [Increased]**
- **wks [Weeks]**

Table ٤,٢٣ shows the change in the score for assessing asthma knowledge in both groups, at the baseline enrollment, there was no significant difference (P>٠,٠٥) between both groups. The TOM group showed a highly significant improvement (P<٠,٠٥) in asthma knowledge, while those in the control group showed a non-significant improvement (P>٠,٠٥). The improvement in asthma knowledge was significantly

greater in the TOM group than in the control (P<٠,٠٥). This improvement is consistent with the improvement in the final outcomes that were shown in the present results, other studies reported smaller reductions in morbidity associated with significant improvements in asthma knowledge (Allen *et al,* ١٩٩٥; Boulet et al, ١٩٩٥ and Schultz *et al*, ٢٠٠٠), however, the relationship between knowledge and morbidity may not be a simple one. Thus, the improvement in asthma knowledge is essential to improve the asthmatic patient quality of life. In ٢٠٠١, Herborg *et al* (٢٠٠١) reported an improvement in asthma knowledge in both intervention and control groups, but it was more significant in the TOM group. A highly significant improvement in the knowledge of patients who were provided by a pharmaceutical care over a course of one year was reported by the German study..

Table ٤,٢٣ Asthma Knowledge

Group	**Disease knowledge [Mean (SD)]**											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	١,٠٦ (٠,١٥)	+ ٠,٩٧ (٠,٠٨)	+ ١,٥٢ (٠,١٤)	+ ١,٧٩ (٠,١٢)	+ ١,٨٣ (٠,١٧)	+ ١,٨٥ (٠,١٨)	+ ١,٨٧ (٠,٢١)	+ ١,٨٧ (٠,٢١)	+ ١,٨٧ (٠,٢١)	+ ١,٨٧ (٠,٢١)	+ ١,٨٧ (٠,٢١)	+ ١,٨٧ (٠,٢١)
Control	١,٧ (٠,١٨)	+ ٠,١٦ (٠,١٦)	+ ٠,٢ (٠,٠٣)	+ ٠,٢ (٠,٠٣)	+ ٠,٢ (٠,٠٣)	+ ٠,٢ (٠,٠٣)	+ ٠,٢ (٠,٠٣)	+ ٠,٢ (٠,٠٣)	+ ٠,٢ (٠,٠٣)	+ ٠,٢ (٠,٠٣)	+ ٠,٢ (٠,٠٣)	+ ٠,٢٦ (٠,٠٣)
P-value	٠,٠٧	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠

- **+ [Increased]**
- **wks [Weeks]**

Table ٤,٢٣ shows the change in the score for assessing drug knowledge in both groups, at the baseline enrollment, there was no significant difference (P>٠,٠٥) between both groups. Both groups showed a significant improvement in the drug knowledge (P<٠,٠٥). The improvement in the TOM group was non-significantly (P>٠,٠٥) greater than that in the control group. The knowledge about the role of each drug in the management of asthma is quite essential to reinforce the appropriate management of asthma.

Table ٤,٢٤ Drug knowledge

Group	Drug knowledge [Mean (SD)]											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	٠,٥٦ (٠,٠٥)	+ ٠,٣١ (٠,٠٤)	+ ٠,٣٧ (٠,٠٤)	+ ٠,٣٩ (٠,٠٤)	+ ٠,٤٣ (٠,٠٥)	+ ٠,٤٣ (٠,٠٥)	+ ٠,٤٣ (٠,٠٥)	+ ٠,٤٣ (٠,٠٥)	+ ٠,٤٣ (٠,٠٥)	+ ٠,٤٣ (٠,٠٥)	+ ٠,٤٣ (٠,٠٥)	+ ٠,٤٣ (٠,٠٥)
Control	٠,٤٠ (٠,٠٤)	+ ٠,٢ (٠,٠٣)	+ ٠,٢٣ (٠,٣)	+ ٠,٢٦ (٠,٣)	+ ٠,٢٦ (٠,٠٣)	+ ٠,٢٦ (٠,٠٣)	+ ٠,٢٦ (٠,٠٣)	+ ٠,٢٦ (٠,٠٣)	+ ٠,٢٦ (٠,٠٣)	+ ٠,٢٦ (٠,٠٣)	+ ٠,٢٦ (٠,٠٣)	+ ٠,٢٦ (٠,٠٣)
P-value	٠,٥٦	٠,١٦٦	٠,٠٧١	٠,٠٥٩	٠,٠٥٩	٠,٠٥٩	٠,٠٥٩	٠,٠٥٩	٠,٠٥٩	٠,٠٥٩	٠,٠٥٩	٠,٠٥٩

Table ٤,٢٥ shows the change in the score of the patients' compliance to the drug therapy in both groups, at the baseline enrollment, there was no significant difference (P>٠,٠٥) between both groups. The TOM group showed a significant improvement (P>٠,٠٥) in the patients' compliance, while that in the control group was non-significant (P>٠,٠٥). The improvement was significantly greater (P<٠,٠٥) in the TOM than in the control at the ١٠th , ١٢th ,١٨th ,٢٠th and ٢٢nd follow-up weeks of evaluation. It was noticed during the study period that a lot of patients might stop taking their treatment particularly the preventive therapy due to financial constraints, reasons, thus, they prefer to purchase their rescue therapy than preventive therapy. Cordina *et al.* (٢٠٠١) reported a non-significant difference between the intervention and the control groups compliance at ١٢ months of evaluation.

Table ٤,٢٥ Patients compliance to drug therapy

Group	Patient Compliance [Mean (SD)]											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	١,٣٥ (٠,١٤)	+ ١,٢٧ (٠,١٤)	+ ١,٣٥ (٠,١٤)	+ ١,٢٢ (٠,١٣)	+ ١,١٦ (٠,١٥)	+ ١,٣٩ (٠,١٦)	+ ١,٣٧ (٠,١٦)	+ ١,٢٥ (٠,١٢)	+ ٠,٩٣ (٠,١٠)	+ ١,٣٧ (٠,١٥)	+ ١,٣٧ (٠,١٤)	+ ١,٢٧ (٠,١٢)
Control	١,٦ (٠,١٥)	+ ٠,٧٦ (٠,٠٨)	+ ٠,٦ (٠,٠٦)	+ ١,١٦ (٠,١٢)	+ ٠,٨٦ (٠,٠٩)	+ ١,٠ (٠,١١)	+ ٠,٦ (٠,٠٦)	+ ٠,٨٦ (٠,٠٨)	+ ٠,٧ (٠,٠٩)	+ ٠,٦٦ (٠,٠٧)	+ ٠,٥٦ (٠,٠٦)	+ ٠,٣٠ (٠,٠٣)
P-value	٠,٢٧٣	٠,٠٥٣	٠,٠٧١	٠,٢٩٣	٠,١٧٦	٠,٠٣٧	٠,٠١٢	٠,٠٧٦	٠,١٦٩	٠,٠٤٨	٠,٠١٩	٠,٠١١

Table ٤,٢٦ shows the change in the score of the patients' compliance to the non-drug therapy measures in both groups, at the baseline enrollment, there was no significant difference (P>٠,٠٥) between both groups. The TOM group showed a significant improvement (P<٠,٠٥) in compliance to non-drug therapy, while those in the control showed a non-significant improvement (P>٠,٠٥). A highly significant greater improvement (P<٠,٠٥) was achieved in the TOM group when compared to that in the control group. The restrictions to the environmental triggers were found to be the most resistant to the improvement in compliance to non-drug therapy, however, the identification and avoidance of triggers remains the best solution for these patients. These results were similar to those reported by Kheir *et al* (٢٠٠٠).

Table ٤,٢٦ Patients' Compliance to non-drug therapy measures

Group	General measures [Mean (SD)]											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	١,٢٥ (٠,١٤)	+ ٠,٧٩ (٠,٠٩)	+ ١,٠ (٠,١٥)	+ ١,٢٩ (٠,١٣)	+ ١,٤٥ (٠,١٥)	+ ١,٦٢ (٠,١٦)	+ ١,٦٢ (٠,١٨)	+ ١,٦٢ (٠,٢٠)	+ ١,٦٦ (٠,١٧)	+ ١,٦٨ (٠,١٨)	+ ١,٦٨ (٠,١٧)	+ ١,٧ (٠,١٨)
Control	١,٥٦ (٠,١٦)	+ ٠,١٦ (٠,٠٢)	+ ٠,١٦ (٠,٠٢)	+ ٠,١٦ (٠,٠٢)	+ ٠,١٣ (٠,٠١)	+ ٠,٢٣ (٠,٠٣)	+ ٠,٢٣ (٠,٠٣)	+ ٠,٢٦ (٠,٠٣)	+ ٠,٢٦ (٠,٠٣)	+ ٠,٢٦ (٠,٠٣)	+ ٠,٢٦ (٠,٠٣)	+ ٠,٢٦ (٠,٠٣)
P-value	٠,٢٢٣	٠,٠٠٥	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠	٠,٠٠٠

Table ٤,٢٧ shows the change in ratio of prescribing inhaled steroids to bronchodilators, at baseline enrollment, there was no significant difference between both groups (P<٠,٠٥). The TOM group showed a highly significant increase in the ratio starting from the ٢nd week of the follow-up till the end of the study, while the control group showed a significant improvement in the ratio since ١٠th week of the follow-up. The TOM group revealed a highly significant greater improvement than the control group (P<٠,٠٥). Salamzadeh *et al* (٢٠٠٠) reported that practices with low ratio of preventers to bronchodilators were of poor quality. These findings showed the improvement in the quality of prescribing in the TOM group.

Table ٤,٢٧ Ratio of inhaled steroids to bronchodilators

Group	Ratio of inhaled steroids to bronchodilators											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	٠,٦	٣,٨	٥	٥,٨	٥,٨	٥,٨	٥,٨	٥,٨	٥,٨	٥,٨	٥,٨	٥,٨
Control	٠,٨	١	١	١,٥	٢,٣	٢,٧	٣,٢	٣,٢	٣,٢	٣,٢	٣,٢	٣,٢

The findings of this study have shown that the patients in the TOM group had better intermediate outcomes than those in the control group. TOM patients had better improvement in the PEFR, technique of inhaler use, asthma and drug knowledge, patients' compliance to drug and non-drug therapy and the ratio of prescribing inhaled steroids to bronchodilators. The face-to-face education of asthmatic patients in the TOM group facilitated the individual learning needs and provided patients interaction and their involvement in decisions regarding their appropriate treatment.

The discussion topics include the concept of asthma being a chronic disease with airway changes, recognition of symptoms, differentiation between rescue and preventer drugs, their proper use and side-effects, environmental control measures, individualized management plan and the importance of regular physician monitoring and follow-up. Although the number of patients in this study were small, its findings implies that the pharmacist's intervention had an effect in terms of improving the quality of care for asthmatic patients and this was shown through the improvement of the intermediate outcome measures in the TOM group. Thus, the collaboration of pharmacists with physicians would improve the asthma management.

Both groups in this study demonstrated improved outcomes during the study period; this may have tended to reduce the apparent effect size of the pharmaceutical service. A number of factors could be at work here. First, the identification of the drug-related problems in the TOM group and their discussion with the medical doctors have changed their prescribing patterns and they have implemented the majority of these interventions to the control group providing some new care practices. Second, filling out questionnaires and meeting at evaluation sessions may be an educational intervention itself. The design of this study imposed certain limitations. Two hospitals, one for the TOM and the other for the control patients were necessary to avoid any overlap between the intervention and control groups. The dropouts of the patients decreased the study sample, some of the healthiest patients dropped out stating that they did not require the service for ٦ months.

c) Assessment of Side-effects

Table ٤,٢٨ shows the percentage of patients with subjective and/or objective side effects, at baseline enrollment there was no significant difference between the groups (P>٠,٠٥). There was a significant reduction (P<٠,٠٥) in the percentage of patients with side-effects in both groups. The reduction of the patients with side effects in the TOM group was non-significantly greater (P>٠,٠٥) than that in the control group.

Table ٤,٢٨ Percentage of patients with side-effects

Group	Percentage of patients reporting Side effects											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	٩١,٦ %	٢٥٪	٣٥,٤٪	١٢,٥٪	١٤,٥ %	١٦,٦ %	١٨,٧٪	١٤,٥٪	٨,٣٪	١٢,٥٪	١٤,٥٪	٨,٣٪
Control	٨٠٪	٣٦,٦٪	٤٠٪	٣٦,٦٪	٢٠٪	٢٠٪	١٣,٣٪	٢٣,٣٪	٢٠٪	١٦,٦٪	١٦,٦٪	٦,٦٪

Tables ٤,٢٩ and ٤,٣٠ show the mean serum potassium and blood glucose levels in both groups, respectively. There was no significant change (P>٠,٠٥) in the levels within the groups and between them. The present results showed that the incidence of hypokalaemia with the use of steroids and β_2 – agonists and hyperglycemia with the use of steroids were not common in patients on inhalation therapy.

Table ٤,٢٩ Serum Potassium levels

Group	Serum potassium levels [Mean (SD)]											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	٣,٥٢ (٠,٤٦)	٣,٥٤ (٠,٤٢)	٣,٦٧ (٠,٤١)	٣,٦٦ (٠,٤٣)	٣,٦٥ (٠,٥٥)	٣,٧٣ (٠,٥٢)	٣,٧ (٠,٥٤)	٣,٨٤ (٠,٤٣)	٣,٧١ (٠,٣٩)	٣,٧١ (٠,٤٨)	٣,٧٧ (٠,٣٧)	٣,٦٦ (٠,٣٦)
Control	٣,٧٦ (٠,٦)	٣,٦٨ (٠,٤٦)	٣,٧٨ (٠,٣٦)	٣,٧٤ (٠,٣٥)	٣,٦٤ (٠,٤٥)	٣,٧٦ (٠,٣٩)	٣,٧٥ (٠,٣)	٣,٦٢ (٠,٤٢)	٣,٥٤ (٠,٢٦)	٣,٥٧ (٠,٣)	٣,٥٨ (٠,٣)	٣,٥٨ (٠,٢٨)
P-value	٠,٢٥٤	٠,١١٥	٠,١٣٢	٠,٣٦٠	٠,٩٤٥	٠,٨٤٦	٠,٤٤٤	٠,٠٢٥	٠,٠٢٨	٠,٠٩٤	٠,٠٧٢	٠,١١٥

Table ٤,٣٠ Blood Glucose

Group	Blood glucose levels [Mean (SD)]											
	Baseline	٢wks	٤wks	٦wks	٨wks	١٠wks	١٢wks	١٤wks	١٦wks	١٨wks	٢٠wks	٢٢wks
TOM	١١٧,١٩ (٥٠)	٩٥,٦٥ (٣١,٧)	٩٥,١ (٢٤,٣)	٩٤,٦ (٣٣,٦)	١٠٨,٥ (٤٥,٥)	٩٧,٢ (٣٢,١)	٩٥,٧ (٢٨,٧)	٨٩,٨ (٣٤,٩)	٩١,٩ (٢٤,٥)	٩٤,٩ (٣٢,٤)	٨٩,٠٢ (٣١,٤)	٩٢,٦ (٢٩)
Control	١٠٩,٤ (٤٢)	٩٧,٣٣ (٢٧,٣)	٩٨,٤ (٣٢,٨)	٩٣,٣ (٢٢,٥)	٩٨,٢ (٢٠,٤)	٩٣,١ (٢٠,٦)	٩٤,٦ (٣٣,٧)	٨٩,٢ (٢١,٣)	٩١,٣ (٢٤,٥)	٩٣,٦ (٤٤,٢)	٨٧,٣ (١٦,٥)	٨٦,٢٣ (١٣,٣)
P-value	٠,٦٥٨	٠,٦٨٨	٠,٥٥٩	٠,٧١١	٠,٩٠٥	٠,٤٢٥	٠,٩٣١	٠,٧٣٧	٠,٤٣٠	٠,٨٢٩	٠,٢٠٦	٠,٣٧٤

٤,٤ Conclusion and Recommendations

The results of this study showed that family history asthma and atopy, allergic rhinitis and skin allergy were common in the majority of the study population. The main source of drugs was the pharmacy, but the main provider of patients' counselling was the physician and this means that pharmacists do not take their responsibilities towards patients' care.

Both groups in this study demonstrated improved outcomes during the study period; this may have tended to reduce the apparent effect size of the pharmaceutical service. A number of factors could be at work here. The most important one is the fact that the identification of the drug-related problems in the TOM group and their discussion with the physicians have improved their prescribing patterns and they have implemented the majority of these interventions to the control group providing some new care practices.

The pharmacist led-interventions resulted in improved final and intermediate patients' outcome measures in the TOM group. The pharmaceutical care intervention has shown an improvement in the management of the asthmatic patients. The results support the value of collaboration between physicians, pharmacists and patients, which improved prescribing, solved drug therapy–related problems and improved the quality of care for asthmatic patients.

Acquisition of the required clinical pharmacy knowledge and skills enables pharmacists to advise on the clinical use of medicines; to promote good prescribing practice and cost effective drug use; and to educate, counsel and advice patients on medicines and health Care. These results are important for implementing pharmaceutical care program through the government policy, which would cost-effectively improve the health status, clinical and psychosocial outcomes and quality of drug therapy.

The recommendations that are suggested from this study include the following:

Health managers, physicians and pharmacists in Sudan should be able to remove the barriers to implement the practice of pharmaceutical care that will increases the likelihood of positive health outcomes.

Pharmacists, health managers and physicians should adopt the pharmaceutical care practice national standards. These national practice standards should be clear including unambiguous set of performance and expectations that are relevant towards improving patient outcomes, and feasible to implement.

Continuing education programs for the pharmacists should be planned to stress the professional, legal, economic and moral benefits of pharmaceutical care.

The faculties of pharmacy in Sudan should modify their undergraduate curriculum to meet the expanded role of the pharmacist.

The challenge is that pharmacists have to prove that what they do is worthwhile, thus local research methods in evaluating pharmaceutical care should be carried out.

Well-equipped specialized asthma centers with well-trained staff and effective tools of patients' education and monitoring should be established for better disease control and quality of patient care.

Chapter ٥

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(A) Demographic data: -

١-Date:
٢-Name:
٣- Age:
٤-Weight:
٥- Height:
٦- Gender:
a) Male ☐ b) Female ☐
٧-Occupation:
٨- Residence:
٩- Education level:
١٠-Address:
Tel:

(B) Patient's medical history:

١-Asthmatic for how long:

٢-Patient knowledge about asthma:

٣- Frequency of acute attacks per week
:
٤- Frequency of nocturnal Symptoms per week:

٥-Severity of asthma:

a) Mild: ☐ b) Moderate: ☐ c) Severe: ☐

٦-Number of admissions for the last six months:

٧-Length of hospital stay:

٨-Days of sickness per week:

٧-Risk factors:

a) Smoker: ☐ For how long:

b) Non smoker: ☐

c) Stopped smoking: ☐ When:

٩-History of allergy:

a) Yes: ☐ b) No: ☐

c) If yes specify:

١٠-Family history of asthma:

a) Yes: ☐ b) No: ☐

١١-Family history of atopy:

Yes: ☐ b) No: ☐

١٢-Presence of concomitant diseases:

a) Yes: ☐ b) No: ☐

b) If yes specify:

Diabètes: ☐ Drugs:

Hypertension: Drugs:

Ischaemic heart disease: ☐ Drugs:

Malaria: ☐ Drugs:

Others: ☐ specify:

Drugs:

(C) Management of asthma:

١- Non-drug therapy measures:

٢- Drug therapy and patients knowledge about their drugs:

	Drug	Preventive	Rescue	Doses
١				
٢				
٣				
٤				
٥				
٦				

٣-Source of the drugs:

a) Pharmacy: ☐ b) Others: ☐ Specify:

٤-Provider of the counseling:

a) Pharmacist: ☐ b) Physician: ☐

b) Self: ☐ d) Others: ☐ Specify:

٥-Accebtability of nebulizer use:

a) Yes: ☐ b) No: ☐ If no why?

٦-If yes: a) At home: ☐ b) At hospital: ☐

٧-Cleaning and disinfection's of nebulizer if used at home:

a) Yes: ☐ b) No: ☐

c) If yes how:

٨-Accebtability of using inhalers:

a) Yes: ☐ b) No: ☐

c) If no why:

٩-Score of inhaler technique:

١٠-Monitoring of asthma:

a) Patient knowledge about Peak flow meter: ☐

b) Clinically ☐

c) Symptomatic self-monitoring: ☐

١١-Assessment of side effects:

		Side effects		
No	Drug	Subjective	Objective	Biochemical
١				
٢				
٣				
٤				
٥				
٦				
٧				
٨				
٩				
١٠				

FOLLOW UP CHART: -

Outcome measure	Baseline	٢ wks	٤ wks	٦ wks	٨ wks	١٠ wks	١٢ wks	١٤ wks	١٦ wks	١٨ wks	٢٠ wks	٢٢ wks
Frequency of acute attacks/week												
Frequency of nocturnal symptoms / week												
Frequency of using β_2 - agonist												
Days of sickness /week												
Score of inhaler technique												
Treatment compliance												
PEFR												
Side effects												
Drug interactions												
Disease knowledge												
Drug knowledge												
Non- drug therapy measures												
Clinical assessment	P RR BP											
Serum potassium												
Serum glucose												

Problems and Interventions

Patient problems	**Interventions**	**Responses**